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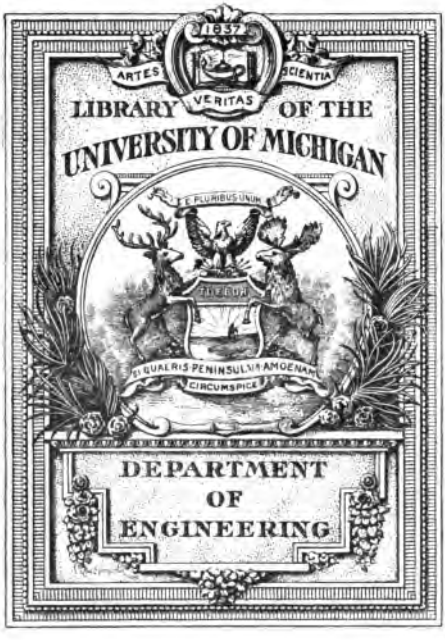
HAND BOOK

SPENCER OTIS CO.

TRACK SUPPLY DEPT.

CHICAGO, ILLINOIS
1913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Railway Track Hand-Book

Edited by
Bruce V. Crandall

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Price, $2.50

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Spencer Otis Company

Chicago, Illinois

Preface

Data on track costs is as a rule available after construction is completed, but is usually applicable to but one particular locality or set of conditions, and is not of service generally. While we recognize the difficulty, in endeavoring to present such information in form that would be of general use, we feel that there is a demand for such information, and offer the data shown in the following pages as a solution of certain portions of the problems that arise annually on every railroad.

271673

Table of Contents

SECTION ONE—Tables relating to track laying and rail renewals.

SECTION TWO—Holding power of track spikes in various kinds of wood ties. Miscellaneous information in regard to cut and screw spikes.

SECTION THREE—Tie plates and their use with screw spikes.

ECONOMY TIE PLATES

ECONOMY NO. 1

THE ECONOMY ROLLED STEEL FOUR-FLANGE TIE PLATE

The Economy Tie Plate No. 1 unquestionably combines strength, rigidity and economy, and meets without question the following requirements:

Ease of application to hardwood ties.
Easy readjustment for track alignment.
Increased adhesion to tie.
Maximum strength to prevent buckling.
Reduction in number of spikes used.
Protection from spike wear from traveling rail.
Maintenance of position when once applied.
A single plate suitable for all track requirements.

This plate is rolled 7 1-4 inches, 8 inches, 8 1-2 inches and 9 inches nominal lengths; 5 inches width; and 5-16-inch, 3-8-inch, 7-16-inch and 1-2-inch thick. Also 7 1-4 inches, 8 inches, 8 1-2 inches and 9 inches nominal lengths by 6 inches width; 5-16-inch, 3-8-inch, 7-16-inch and 1-2-inch thick. Also 7 1-4 inches, 8 inches, 8 1-2 inches and 9 nominal lengths; by 7 inches width; 5-16-inch, 3-8-inch, 7-16-inch and 1-2-inch thick.

RAIL TABLE

WEIGHT PER YARD.	RAIL REQUIRED TO LAY		ONE TON LAYS		WEIGHT OF ONE	
	ONE MILE OF TRACK	100 FEET OF TRACK.	MILES OF TRACK	FEET OF TRACK	30 FOOT RAIL	33 FOOT RAIL
LBS	TONS (2240 LBS.)				TONS	
30	47.14	.893	.0212	112.0	.134	.147
35	55.00	1.042	.0182	96.0	.156	.172
40	62.86	1.190	.0160	84.0	.178	.196
45	70.71	1.339	.0141	74.6	.200	.220
48	75.43	1.429	.0132	70.0	.212	.233
50	78.57	1.488	.0128	67.2	.222	.243
52	81.71	1.548	.0122	64.6	.232	.256
54	84.86	1.605	.0118	62.2	.240	.265
55	86.43	1.635	.0116	61.1	.245	.270
56	88.00	1.667	.0114	60.0	.250	.275
57	89.57	1.696	.0112	58.9	.254	.280
58	91.14	1.725	.0110	57.9	.259	.285
60	94.29	1.788	.0106	56.0	.268	.295
61	95.86	1.815	.0104	55.1	.272	.300
62	97.42	1.845	.0103	54.2	.277	.305
63	99.00	1.875	.0101	53.3	.281	.310
64	100.57	1.905	.0099	52.5	.286	.315
65	102.14	1.934	.0098	51.7	.290	.320
66	103.71	1.954	.0096	50.9	.295	.324
67	105.29	1.994	.0095	50.2	.299	.329
68	106.86	2.024	.0094	49.4	.304	.334
69	108.43	2.054	.0092	48.7	.305	.339
70	110.00	2.083	.0091	48.0	.312	.344
71	111.57	2.113	.0090	47.3	.317	.349
72	113.14	2.143	.0088	46.7	.321	.354
73	114.71	2.172	.0087	46.0	.326	.358
75	117.86	2.232	.0085	44.8	.335	.368
76	119.43	2.262	.0084	44.2	.340	.374
78	122.57	2.322	.0082	43.1	.346	.380
80	125.71	2.381	.0080	42.0	.357	.393
82	128.86	2.440	.0078	41.0	.366	.403
85	133.57	2.530	.0075	39.5	.380	.417
88	138.29	2.619	.0072	38.2	.393	.432
90	141.43	2.678	.0071	37.3	.402	.442
92	144.57	2.738	.0069	36.5	.411	.452
95	149.29	2.827	.0067	35.4	.424	.466
98	154.00	2.917	.0065	34.3	.438	.481
100	157.14	2.976	.0064	33.6	.446	.491
110	172.86	3.274	.0058	30.5	.491	.540
120	188.57	3.571	.0053	28.0	.534	.587
135	212.14	4.018	.0047	24.8	.603	.663

ECONOMY TIE PLATES

ECONOMY NO. 2

THE ECONOMY ROLLED STEEL FOUR-FLANGE TIE PLATE

The Economy Tie Plate No. 2 unquestionably combines strength, rigidity and economy, and meets without question the following requirements:

Ease of application to hardwood ties.
Easy readjustment for track alignment.
Increased adhesion to tie.
Maximum strength to prevent buckling.
Reduction in number of spikes used.
Protection from spike wear from traveling rail.
Maintenance of position when once applied.
A single plate suitable for all track requirements.

This plate is rolled 7 1-4 inches, 8 inches, 8 1-2 inches and 9 inches nominal lengths; 5 inches width; and 3-8-inch and 1-2-inch thick. Also 7 1-4 inches, 8 inches, 8 1-2 inches and 9 inches nominal lengths by 6 inches width; *3-8-inch, 7-16*-inch and 1-2-inch thick. Also 7 1-4 inches, *8 inches, 8 1-2* inches and 9 inches nominal lengths by 7 *inches width;* 3-8-inch, 7-16-inch and 1-2-inch thick.

TABLE OF SPLICES.

WEIGHT RAIL PER YD.	NUMBER OF JOINTS OR PAIRS OF SPLICES PER TON OF RAIL. LENGTH OF RAIL.						
	ALL 33 FT.	33+10% SHORT	ALL 30 FT.	30+10% SHORT	ALL 28 FT.	ALL 26 FT.	ALL 24 FT.
30	6.79	6.94	7.47	7.58	8.00	8.62	9.33
35	6.82	5.95	6.40	6.50	6.86	7.38	8.00
40	6.09	5.20	5.60	5.69	6.00	6.46	7.00
45	4.53	4.62	4.98	5.05	5.33	5.74	6.22
48	4.24	4.34	4.67	4.74	5.00	5.38	5.89
50	4.07	4.16	4.48	4.55	4.80	5.17	5.60
52	3.92	4.01	4.31	4.37	4.62	4.97	5.39
54	3.77	3.86	4.15	4.21	4.44	4.79	5.19
55	3.70	3.79	4.07	4.14	4.36	4.70	5.09
56	3.64	3.72	4.00	4.06	4.29	4.62	5.00
57	3.57	3.65	3.93	3.99	4.21	4.53	4.91
58	3.51	3.59	3.86	3.93	4.14	4.46	4.83
60	3.39	3.47	3.73	3.79	4.00	4.31	4.67
61	3.34	3.41	3.67	3.73	3.93	4.24	4.59
62	3.28	3.35	3.61	3.67	3.87	4.16	4.52
63	3.23	3.30	3.56	3.61	3.81	4.10	4.45
64	3.18	3.25	3.50	3.55	3.75	4.04	4.38
65	3.13	3.20	3.45	3.50	3.69	3.98	4.31
66	3.09	3.15	3.39	3.44	3.64	3.92	4.24
67	3.04	3.10	3.34	3.39	3.58	3.86	4.18
68	2.99	3.05	3.29	3.34	3.53	3.80	4.12
69	2.95	3.01	3.25	3.30	3.48	3.75	4.06
70	2.91	2.97	3.20	3.25	3.43	3.69	4.00
71	2.87	2.93	3.15	3.20			
72	2.83	2.89	3.11	3.16			
73	2.79	2.85	3.07	3.11			
75	2.72	2.77	2.99	3.03			
76	2.68	2.73	2.95	2.99			
78	2.61	2.66	2.87	2.91			
80	2.55	2.60	2.80	2.84			
82	2.49	2.53	2.73	2.77			
85	2.40	2.45	2.64	2.68			
88	2.31	2.36	2.55	2.58			
90	2.26	2.31	2.49	2.53			
92	2.21	2.26	2.43	2.46			
95	2.14	2.19	2.36	2.39			
98	2.08	2.12	2.29	2.31			
100	2.04	2.08	2.24	2.27			
110	1.85	1.89	2.04	2.07			
120	1.70	1.73	1.86	1.90			
135	1.51	1.54	1.66	1.68			

NO. OF JOINTS OR PAIRS OF SPLICES.

LENGTH OF RAIL	PER MILE OF TRACK.	PER 100' OF TRACK.
ALL 33 FT	320.	6.06
33+10% SHORT	327.4	6.20
ALL 30 FT.	352	6.67
30+10% SHORT	357.4	6.77
ALL 28 FT.	377.	7.14
ALL 26 FT.	406.	7.69
ALL 24 FT.	440.	8.33

NOTE: 1 TON = 2240 LBS.

THE ECONOMY ROLLED STEEL FOUR-FLANGE SHOULDER TIE PLATE

Showing Plate as Intermediate. Nos. 1-2

A glance at this illustration will show that when the plate and rail are in position, the thrust of the rail is expended on the shoulder where the strength units are greatest, and not on the unprotected spike.

A reduction in the number of spikes used is effected by making the two spikes hold both the plate and the rail, while the old trouble of spike shearing is abolished by the protection which the shoulder affords the spike.

The shoulder serves the double purpose of keeping the rail from shifting laterally and protecting the spike from the shearing action by the rail. It is an established fact that the shoulder permits of a reduction of 33 1-3% to 50% in the number of spikes used, two only being requisite *for each plate,* which in itself is a feature of economy that *should not be* overlooked.

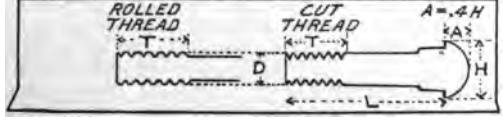
TRACK BOLTS

DIMENSIONS OF STANDARD TRACK BOLTS				NUMBER IN KEG OF 200 LBS.		RAILS-33 FT+10% SHORT'R NUMBER OF KEGS PER 100 FT. OF TRACK		MILE OF TRACK	
SEE DRAWING BELOW				THREAD		4-BLT JNT.	6-BLT JNT.	4-BLT JNT.	6-BOLT JOINT
D	L	H	T	CUT	ROLLED				
HEXAGON NUTS.									
1"	4 3/4"	1 13/16"	2"	109		.23	.34	12.0	18.0
"	4 1/2	"	"	114		.21	.32	11.5	17.2
"	4	"	"	124		.20	.30	10.6	15.9
"	3 3/4	"	"	129		.19	.29	10.1	15.2
7/8	4 1/2	1 9/16	1 3/4	156	167	.16	.24	8.4	12.6
"	4 1/4	"	"	162	172	.15	.23	8.1	12.1
"	4	"	"	168	177	.15	.22	7.8	11.7
"	3 1/2	"	"	180	187	.14	.21	7.3	10.9
3/4	4 3/4	1 3/8	1 1/2	212	233	.12	.18	6.2	9.3
"	4 1/2	"	"	221	242	.11	.17	5.9	8.9
"	4 1/4	"	"	229	251	.11	.16	5.7	8.6
"	4 1/8	"	"	233	255	.11	.16	5.6	8.4
"	4	"	"	237	260	.11	.16	5.6	8.3
"	3 3/4	"	"	245	273	.10	.15	5.4	8.0
"	3 3/8	"	"	250	275	.10	.15	5.2	7.8
"	3 1/2	"	"	255	280	.10	.15	5.1	7.7
"	3 1/4	"	"	265	286	.09	.14	4.9	7.4
"	3	"	"	275	293	.08	.13	4.8	7.1
5/8	3	1 1/8	1 1/2	426		.06	.09	3.1	4.6
"	2 3/4	"	1 3/8	442		.05	.08	3.0	4.5
"	2 1/2	"	1 1/4	470		.05	.08	2.8	4.2
SQUARE NUTS									
1"	4 3/4	1 3/16	2	102		.24	.36	12.8	19.2
"	4 1/2	"	"	107		.23	.35	12.2	18.3
"	4	"	"	117		.21	.32	11.2	16.8
"	3 3/4	"	"	122		.20	.30	10.7	16.1
7/8	4 1/2	1 9/16	1 3/4	148	160	.17	.25	8.8	13.3
"	4 1/4	"	"	153	164	.16	.24	8.6	12.8
"	4	"	"	158	169	.15	.23	8.3	12.4
"	3 1/2			170	179	.15	.22	7.7	11.6
3/4	4 3/4	1 3/8	1 1/2	204	226	.13	.19	6.4	9.6
"	4 1/2	"	"	213	235	.12	.18	6.2	9.2
"	4 1/4	"	"	221	243	.11	.17	5.9	8.9
"	4 1/8	"	"	225	246	.11	.16	5.8	8.7
"	4	"	"	229	250	.11	.16	5.7	8.6
"	3 3/4	"	"	237	260	.11	.16	5.6	8.3
"	3 3/8	"	"	242	263	.10	.15	5.4	8.1
"	3 1/2	"	"	247	266	.10	.15	5.3	8.0
"	3 1/4	"	"	256	272	.10	.15	5.1	7.7
"	3	"	"	265	278	.09	.14	4.9	7.4
5/8	3	1 1/8	1 1/2	402		.06	.09	3.2	4.8
"	2 3/4	"	1 3/8	416		.06	.09	3.1	4.7
"	2 1/2	"	1 1/4	436		.05	.08	3.0	4.5

WITH RAILS ALL 33 FEET LONG DEDUCT 2 % FROM NUMBER OF KEGS SHOWN IN TABLE,
" " 30 " " ADD 8 % TO " " " "
" " 30 FT. + 10 % SHORTER " 10 % " " " "
" " ALL 28 FEET LONG " 13 % " " " "

DIMENSIONS OF NUTS FOR STAND. TRACK BOLTS

THICKNESS OF NUT = DIAMETER OF BOLT,
SHORT DIAM. OF NUT = 1 1/2 (DIAM. OF BOLT) + 1/4"



ECONOMY TIE PLATES

THE ECONOMY ROLLED STEEL FOUR-FLANGE SHOULDER TIE PLATE

Showing Plate as a Joint Plate. Nos. 1-2

This illustration shows the plate in position applied to a joint under the angle bar. This feature removes the necessity of specifying Joint, Shoulder and Intermediated Plates, the old method which, in most every instance, complicated matters materially, as one length of plate of this design will answer for all purposes.

SPIKES.
TRACK, BOAT AND WIRE.

STANDARD STEEL R.R. SPIKES.

LGTH UNDER HEAD	SHANK	HEAD LGTH.	HEAD WDTH	POINT LGTH.	AV. NO. IN KEG 200 LBS.	LGTH UNDER HEAD	SHANK	HEAD LGTH.	HEAD WDTH	POINT LGTH	AV. NO. IN KEG 200 LBS.
5½"	9/16"	1 3/16"	1¼"	1⅛"	340	4"	½"	1¼"	1 1/16"	1"	600
5"	"	"	"	"	380	3½"	"	"	"	⅞"	620
"	½"	1¼"	1 1/16"	1"	490	4"	7/16"	1⅛"	⅞"	"	684
4½"	"	"	"	"	536	3½"	⅜"	1"	¾"	¾"	1170

KEGS OF 5½" x 9/16" SPIKES REQUIRED (4 SPIKES TO TIE

TIES PER MILE	KEGS PER 100 FT.	KEGS PER MILE	TIES PER MILE	KEGS PER 100 FT.	KEGS PER MILE	TIES PER MILE	KEGS PER 100 FT.	KEGS PER MILE
2080	0.46	24.5	2560	0.57	30.1	3040	0.68	35.8
2112	0.47	24.9	2640	0.59	31.1	3168	0.71	37.3
2240	0.50	26.4	2720	0.61	32.0	3200	0.71	37.6
2288	0.51	26.9	2816	0.63	33.1	3344	0.74	39.3
2400	0.53	28.2	2880	0.64	33.9	3360	0.75	39.5
2464	0.55	29.0	2992	0.67	35.2	3520	0.78	41.4

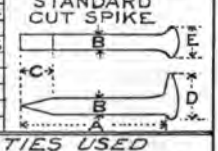
SQUARE BOAT SPIKES
Average number in keg of 200 pounds.

THICK	Length of Spike in Inches											
	3	4	5	6	7	8	9	10	11	12	14	16
¼	3000	2375	2050	1825								
5/16	1660	1360	1230	1175	990	880						
3/8	1320	1140	940	800	650	600	525	475				
7/16				600	590	510	400	360	320	230		
½				450	375	335	300	275	260	240		
⅝						260	240	220	205	190	175	160

WIRE SPIKES

NO PER POUND	37	33	29	23	18	13	10	9	7½	6½	4¼	3⅓	3¼	2⅔
LENGTH	3"	3¼	3½	4	4½	5	5½	6	6½	7	8	9	10	12
NAME	10d	12d	16d	20d	30d	40d	50d	60d	5/16"	"	3/8"	"	"	"

A	B	C	D	E
3½	3/8	3/4	1	3/4
4	7/16	7/8	1⅛	7/8
3½	1/2	"	1¼	1 1/16
4	"	1	"	"
4½	"	"	"	"
5	"	"	"	"
5	9/16	1⅛	1 7/16	1¼
5½	"	"	"	"



NUMBER OF CROSS TIES USED

WITH 30 FT. RAILS			WITH 33 FT. RAILS		
PER RAIL	PER 100 FT.	PER MILE	PER RAIL	PER 100 FT.	PER MILE
14	47	2464	15	46	2400
15	50	2640	16	49	2560
16	53	2816	17	52	2720
17	57	2992	18	55	2880
18	60	3168	19	58	3040
19	63	3344	20	61	3200
20	67	3520	21	64	3360
			22	67	3520

ECONOMY TIE PLATES

ECONOMY NO. 4

THE ECONOMY STANDARD FOUR-FLANGE TIE PLATE

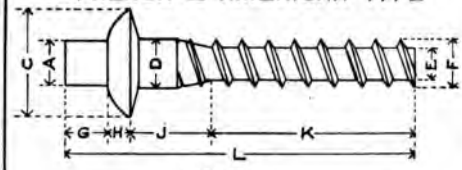
A four-flange plate, new in design, which meets every requirement demanded of tie plates of this character.

Rolled 5-inch, 6-inch and 7-inch widths; 3-8-inch, 7-16-inch and 1-2-inch thick.

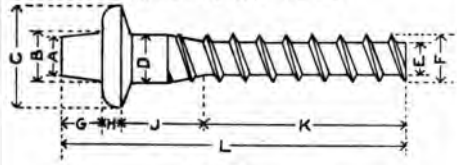
Sheared and punched to suit rail base.

SCREW SPIKES

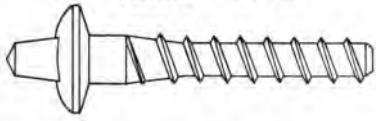
No. 1.
FRENCH & AMERICAN TYPE



No. 2.
AMERICAN TYPE



No. 3
GERMAN TYPE



GENERAL DIMENSIONS											WGT. OZ.
A	B	C	D	E	F	G	H	J	K	L	
TYPE No. 1.											
53/64"	53/64"	2"	29/32"	5/8"	29/32"	13/16"	7/16"	1 1/4"	4 1/2"	6 5/8"	18
13/16	7/8	"	7/8	11/16	15/16	11/16	3/8	15/16	4 9/16	6 3/16	18
"	"	"	"	5/8	7/16	7/8	"	2 1/4	3 3/4	7 1/4	17
7/8×5/8		2 1/16	3/4	1/2	3/4	3/4	1/4	2 1/4	2 7/8	6 1/8	13
TYPE No. 2.											
25/32"	7/8"	1 7/8"	7/8"	3/4"	1"	1 1/16"	3/8"	1 1/4"	4 1/4"	6 5/8"	19
"	"	"	"	11/16	15/16	"	"	"	"	"	17
"	"	"	"	5/8	7/8	"	"	"	"	"	16

ECONOMY TIE PLATES

ECONOMY NO. 6

THE ECONOMY RIBBED TOP REINFORCED SHOULDER PLATE

This plate is entirely new in design. Its Top Surface has alternate Flat and Round top ribs or corrugations, while its Bottom Surface is perfectly flat, except the reinforcement under the shoulder. This is an important feature—to prevent buckling and to materially strengthen the plate at the point where it is most needed.

Rolled 8-inch, 8 1-2-inch and 9-inch long; 6-inch, 6 1-2-inch, 7-inch, 8-inch and 8 1-2-inch wide; 3-8-inch, 7-16-inch and 1-2-inch thick, or thicker, if wanted.

JOINTS.

WEIGHT OF RAIL PER YARD	WEIGHT OF ONE JOINT (IN POUNDS) Per inch of length (exclusive of bolts)				KIND OF JOINT.
	A.R.A. Sec's. A	B	A.S.C.E.	SPECIAL SEC.	
50					ANGLE BAR
55			1.25	•	
60			1.40		
65			1.53		
70			1.67		
75			1.78		
80			1.90		
85			2.06		
90			2.25		
100			2.63		
110			3.02		
120					
135					
70	2.4		2.3		CONTINUOUS
75			2.4		
80	2.7		2.6		
85			2.8		
90	3.2		3.0		
100	3.4		3.2		
110					
120					
135					
70			2.72		WEBER
75			2.78		
80			2.87		
85			3.07		
90			3.84		
100			3.90		
110					
120					
135					
70					WOLHAUPTER
75			2.5		
80	2.8		2.7		
85			2.9		
90	3.3				
100	3.5		3.3		
110					
120					
135					

ECONOMY TIE PLATES

ECONOMY NO. 8

THE ECONOMY RIBBED TOP REINFORCED SHOULDER FLANGED PLATE

This plate is entirely new, and of the same design as our No. 6 Plate, except we have added two transverse depending flanges—designed to give the plate adhesion to the tie and assist in the holding power of the spikes.

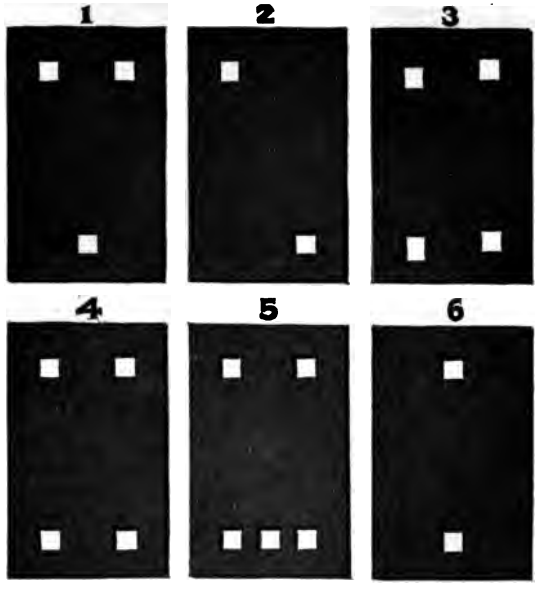
Rolled 8-inch, 8 1-2-inch and 9-inch long; 5-inch, 6-inch, 7-inch, 8-inch and 8 1-2-inch wide; 3-8-inch, 7-16-inch and 1-2-inch thick, or thicker, if wanted.

JOINTS

WGT OF RAIL PER YD.	WEIGHT OF TWO BARS, IN LBS, EXCLUSIVE OF BOLTS											
	BARS 24" LONG				BARS 28" LONG				BARS 30" LONG			
	A.R.A.		ASCE		A.R.A.		ASCE		A.R.A.		ASCE	
	A	B			A	B			A	B		
BONZANO												
70			50								64	
75			54									
80			55									
85			56								84	
90	64		62									
100	68		64									
110												
120												
135												
DUQUESNE												
70			52								63	
75			55									
80			58				68					
85			62				70				76	
90		62	66		75	70	79					
100			72		96	89				89	85	
110												
120												
135												
100 % BARS 26" LONG												
70			47				56				64	
75			57				61				65	
80			64				68				72	
85			67				71				75	
90	77	65	74		81	69	78		87	73	83	
100			82				87				93	
110												
120												
135												

SIZE OF PLATE	RAIL	WGHT. OF PLATE, LBS.			
		24"	26"	28"	30"
3/8" × 10"	75 TO 85	26.4	28.5	30.6	32.7
" × 10½	90 - 100	27.7	29.9	32.2	34.4
7/16 × 10	75 - 85	30.9	33.4	35.9	38.3
" × 10½	90 - 100	32.3	34.9	37.5	40.1

ABBOTT



SUGGESTIONS FOR PUNCHING THE ECONOMY STANDARD ROLLED STEEL TIE PLATE No. 4

Fig. 1. Shows 3-hole punching and can be used for either right or left-hand spiking, or on curvatures, using the three spikes, two on the outside of the rail and one inside of the rail.

Fig. 2. Shows left-hand punching and the dotted lines for right-hand punching.

Fig. 3. Shows plate punched for two sections of rail.

Example: Should your present rail be a 70-lb. section, having a rail base of 4 5-8-inch, and you contemplate increasing this in the future to an 85-lb. rail, having a 5 3-16-inch rail base, these plates will fit both conditions. When the lighter rail is removed, the heavier rail can be laid without disturbing or creating a new seat in the tie for the plate. This is a very economical feature to the plate consumer.

Fig. 4. Shows four-hole punching designed to do away with the confusion occasioned when using tie plates punched for right and left-hand. With the four-hole punching shown, the plate becomes general for either right or left hand.

Fig. 5. Shows special punching of five holes, which is sometimes used for joint plates.

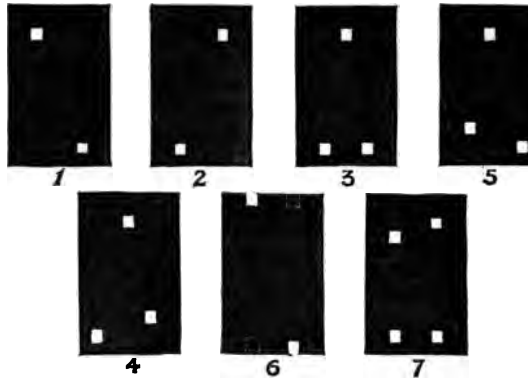
Fig. 6. Shows special 2-hole punching for triangular ties.

ONE MILE OF MAIN TRACK
ESTIMATED COST

	A	B	C	D	E	F	G
	BALLAST						
	Cubic Yards Per Mile	CRUSHED STONE; WASHED GRAVEL		BURNED CLAY, CEMENTG. GRAVEL, CHATS, CHERT, SLAG, LOOSE GRAVEL.			SAND, CINDERS, EARTH
		Cost per cub. yard in surfaced track					
		$1.00	85c	70c	60c	50c	40c
1.	4500	4500	3825	3150	2700	2250	1800
2.	4000	4000	3400	2800	2400	2000	1600
3.	3500	3500	2975	2450	2100	1750	1400
4.	3000	3000	2550	2100	1800	1500	1200
5.	2500	2500	2125	1750	1500	1250	1000
6.	2000	2000	1700	1400	1200	1000	800
	RAIL						
	LBS. PER YD.	TONS PER MILE	Cost per ton including freight				
			$40	$35	$32	$30	$29	$28
7.	110	172.85	6914	6050	5530	5185	5013	4840
8.	100	157.14	6286	5500	5028	4714	4557	4400
9.	95	149.29	5972	5225	4777	4479	4329	4180
10.	90	141.43	5657	4950	4525	4243	4101	3960
11.	85	133.57	5343	4675	4274	4007	3874	3740
12.	80	125.71	5028	4400	4023	3771	3646	3520
13.	75	117.86	4714	4125	3771	3536	3418	3300
14.	70	110.00	4400	3850	3520	3300	3190	3080
	CROSS TIES							
	METAL, CONCRETE, &c.		WOOD-treated & untreated.					
	Hundreds per Mile	Cost each		No per Mile	Cost each delivered			
		2.00	1.50		$1.00	80c	60c	40c
15.	32	6400	4800	3500	3500	2800	2100	1400
16.	30	6000	4500	3300	3300	2640	1980	1320
17.	28	5600	4200	3200	3200	2560	1920	1280
18.	26	5200	3900	3100	3100	2480	1860	1240
19.	24	4800	3600	3000	3000	2400	1800	1200
20.	22	4400	3300	2800	2800	2240	1680	1120
21.	20	4000	3000	2600	2600	2080	1560	1040
22.	18	3600	2700	2400	2400	1920	1440	960
	TIE FASTENINGS							
	RAIL BRACES & ANCHORS - EXTRA			CROSS TIES PER MILE				
				3500	3200	3000	2800	2600
23.	TIE PLATES - 15c each			1050	960	900	840	780
24.	COM. SPIKES @ 1c "			140	128	120	112	104
25.	SCREW " 2¾c			385	352	330	308	286
26.	METAL TIE BOLTS - 2c			280	256	240	224	208
	JOINT FASTENINGS - complete, with bolts.							
	RAIL wgt. per yd.	20"	24"	28"	32"	36"	40"	
		ANGLE BAR - Standard Specifications						
27.	110 to 100	300	360	420	480	540	600	
28.	90 - 80	210	260	300	340	380	420	
29.	70 - 60	160	190	220	250	280	320	
	ANGLE BAR - Special Specifications							
30.	110 - 100	360	430	500	570	640	720	
31.	90 - 80	250	310	360	410	460	500	
32.	70 - 60	190	220	260	300	340	380	
	SPECIAL JOINTS							
33.	110 - 100		540	640	730			
34.	90 - 80		480	560	640			
35.	70 - 60		350	400	450			
36.	TRACK LAYING		900	800	700	600	500	
	TRACK SURFACING - covered by ballast cost above.							

TOTAL COST MAY VARY FROM $6000 TO $20,000 PER MILE.

ECONOMY TIE PLATES



SUGGESTIONS FOR PUNCHING THE ECONOMY ROLLED STEEL SHOULDER TIE PLATES

Nos. 1, 2, 3, 6, 8 and 12

Fig. 1. Shows plate punched for left-hand spiking.

Fig. 2. Shows plate punched for right-hand spiking.

Fig. 3. Shows plate punched 3-hole, for use on extreme curvature, and can be used either for right or left hand.

Figs. 4 and 5. Show plates punched for two different sections of rail, with left and right-hand punching.

Example: Should your present rail be a 70-lb. section, having a rail base of 4 5-8-inch, and you contemplate increasing this in the future to an 85-lb. rail having a 5 3-16-inch rail base, these plates will fit both conditions. When the lighter rail is removed, the heavier rail can be laid without disturbing or creating a new seat in the tie for the plate. This is a very economical feature to the plate consumer.

Fig. 6. Shows plate punched for a joint, where no slotting is made through the angle bar, but is generally used on a 3-tie joint, which is supported by the shoulder plates on either side of the joint, the joint plate acting as a wear plate. The angle bar fits over the shoulder on this plate.

Fig. 7. Shows plate punched specially with four holes to be used on joints where slotting and angle bar, or the spiking in contact with the rail base can be used.

CURRENT PRICES
NEW TRACK MATERIAL

	1911	1913	19..
STEEL RAILS; Standard sections, 50 lb. and over			
Bessemer, per gross ton, f. o. b. Pittsburg	$28.00-$29.00	$28.00	.....
Bessemer, per gross ton, f. o. b. Chicago	28.00- 28.50	28.00	.....
Bessemer, per gross ton, f. o. b. Birmingham	28.00	28.00	.....
Bessemer, per gross ton, f. o. b.			
Open Hearth, per gross ton, f. o. b. Pittsburg	30.00	30.00	.....
Open Hearth, per gross ton, f. o. b. Chicago	30.00	30.00	.....
Open Hearth, per gross ton, f. o. b. Birmingham	30.00	30.00	.....
Open Hearth, per gross ton, f. o. b.			
Ferro-Titanium | .10% metallic Titanium		1.60	.....
Nickel-Chrome | extra, per g. tr.			
High-Carbon | f. o. b. mill	1.50- 4.00		
Manganese, rolled, per g. t., f. o. b. mill	75.00- 90.00	70.00	.....
In lots of less than 500 tons add per g. t.			
RAIL JOINTS—			
Steel angle bars, standard shapes			
With rail orders, per cwt., f. o. b. Pittsburg	1.50	1.50	.....
With rail orders, per cwt., f. o. b. Chicago			
With rail orders, per cwt., f. o. b. Birmingham			
With rail orders, per cwt., f. o. b.			
In car lots, per cwt., f. o. b. Pittsburg	1.60	1.60	.....
In car lots, per cwt., f. o. b. Chicago			
In car lots, per cwt., f. o. b. Birmingham			
In car lots, per cwt., f. o. b.			
Steel angle bars, special shapes, extra per cwt	10c-20c		.....
Steel angle bars, special composition, extra per cwt	5c-20c		.....
Special or patented joints:			
Duquesne, per cwt., f. o. b. mill	2.20	2.30	.....
Continuous, per cwt., f. o. b. mill	1.70	1.80	.....
Bonzano, per cwt., f. o. b. mill	2.25	2.25	.....

CONTINUED TO PAGE 26

CURRENT PRICES
NEW TRACK MATERIAL

CONTINUED FROM PAGE 24

	1911	1913	19..
Weber (with filler and bolts) per cwt., f. o. b. mill	$ 2.20–$ 2.50	$ 2.40	.....
100% per cwt., f. o. b. mill	2.40	2.50	.....
Wolhaupter, per cwt., f. o. b. mill	1.70	1.80	.....
American, per cwt., f. o. b. mill	1.75	1.65	.....
Abbott Plate, per cwt., f. o. b. mill			
Usual allowance, per cwt. for reheating and cooling in air		.20	.....
Usual allowance, per cwt. for reheating and cooling in oil		.30	.....
TRACK SPIKES—			
5/16", Standard, cut, car lots, per cwt., f. o. b. Pittsburg	1.40– 1.60	1.90	.....
5/16", Standard, cut, car lots, per cwt., f. o. b. Chicago	1.50– 1.75	2.00	.....
5/16", Standard, cut, car lots, per cwt., f. o. b.			
For 1/2", 7/16", 3/8" and 1/4" sizes, add 10c, 20c, 40c and 60c extra, respectively:			
SCREW SPIKES, per cwt., f. o. b.	2.20– 2.50	2.40	.....
BOAT SPIKES, per cwt., f. o. b. Pittsburg	1.65	2.00	.....
BOAT SPIKES, per cwt., f. o. b.			
TRACK BOLTS, Standard, cut thread, car lots:			
Square nuts, per cwt., f. o. b. Chicago	1.90– 2.30	2.40	.....
Square nuts, per cwt., f. o. b.			
Hexagon nuts, per cwt., f. o. b. Chicago	2.00– 2.40	2.50	.....
Hexagon nuts, per cwt., f. o. b.			
Rolled thread, extra, per cwt			
Special treatment, extra per cwt			
NUT LOCKS, Verona, 1/2", for 7/8" bolt, per M, f. o. b. mill	5.50	6.00	.....
Verona, 1/2", for 1/8" bolt, per M, f o. b			
Special, 1/2", for 1/8" bolt, per M, f o. b			
TIE PLATES, per net ton, f. o. b. Chicago		34.00	.....
Per net ton, f. o. b			
RAIL BRACES, each		10c–17c	.....
RAIL ANCHORS, each	15c–20c	18c	

CURRENT PRICES
OLD TRACK MATERIAL

	1911	1913	19..
STEEL RAILS—			
Re-laying, subject to inspection:			
Per gross ton, f. o. b. Pittsburg			
Per gross ton, f. o. b. Chicago	$22.00–$24.00	$24.00	
Per gross ton, f. o. b. Birmingham			
Per gross ton, f. o. b.			
Re-rolling, subject to inspection:			
Per gross ton, f. o. b. Pittsburg	12.50– 15.00	17.00	
Per gross ton, f. o. b. Chicago	12.25– 14.00	16.50	
Per gross ton, f. o. b.			
Cost of re-rolling, per gross ton, f. o. b. mill		5.00	
Scrap, No. 1, per gross ton, f. o. b. Pittsburg	12.00– 15.00	15.50	
Scrap, No. 1, per gross ton, f. o. b. Chicago	9.50– 12.50	13.75	
Scrap, No. 1, per gross ton, f. o. b. Birmingham	8.00– 10.50	11.00	
Scrap, No. 1, per gross ton, f. o. b.			
Scrap, less than 3 ft. lengths, per g. t., f. o. b. Chicago	10.75– 13.50	14.75	
Scrap, less than 3 ft. lengths, per g. t., f. o. b.			
Guard rails, frogs, switches, cut apart, per g. t., f. o. b. Chicago	9.75– 12.00	14.00	
Guard rails, frogs, switches, cut apart, per g. t., f. o. b.			
OLD STEEL ANGLE BARS,			
Per net ton, f. o. b. Pittsburg		12.00	
Per net ton, f. o. b. Chicago	8.75– 12.00	13.00	
Per net ton, f. o. b.			
WROUGHT SCRAP, per net ton, f. o. b. Pittsburg	10.75– 13.00	13.50	
Per net ton, f. o. b. Chicago	10.00– 13.25	13.50	
Per net ton, f. o. b. Birmingham	9.00– 11.25	12.00	
Per net ton, f. o. b.			
CAST SCRAP, No. 1, per net ton, f. o. b. Pittsburg	10.50– 13.25	12.00	
Per net ton, f. o. b. Chicago	10.00– 12.75	13.50	
Per net ton, f. o. b. Birmingham	8.50– 9.00	12.00	
Per net ton, f. o. b.			
OLD IRON RAILS, per gross ton, f. o. b. Pittsburg	14.50– 16.25	16.50	
Per gross ton, f. o. b. Chicago	14.00– 16.00	18.25	
Per gross ton, f. o. b. Birmingham	11.00– 13.50	14.75	
Per gross ton, f. o. b.			
OLD IRON ANGLE BARS, per net ton, f. o. b. Chicago	11.75– 14.50	16.50	

NOTE—Above prices are applicable, as a general rule, to carload lots. Deduct 5% to 10% from branded weight of second hand rail as allowance *for wear.*

MISCELLANEOUS MATERIAL PRICES

	1898–1907	1911	1913	19..
PIG IRON, per gross ton:				
Foundry No. 2, Standard, Philadelphia..	–$25.80	$14.85–$15.50	$18.25	.....
Foundry No. 2, local, Chicago.	11.10– 26.85	14.00– 15.50	17.50	.....
Foundry No. 2, Valley Furnace.....		13.00– 13.75	17.00	.....
Foundry No. 2, Southern, Cincinnati....	9.25– 26.00	13.00– 14.25	17–25	
Foundry No. 2, Birmingham..		9.75– 11.00	14.00	.....
Basic, Philadelphia.....	12.80– 24.65	14.25– 15.25	18.00	.....
Basic, Valley Furnace.....		12.25– 13.75	16.50	.....
Bessemer, Pittsburg.....	9.90– 24.25	14.90– 15.90	17.25	.....
Gray Forge, Pittsburg.....		13.25– 14.40	16.40	.....
Lake Superior, charcoal, Chicago.....		16.50– 18.00	18.25	.....
STEEL BILLETS, per gross ton:				
Wire rods, Pittsburg.....		25.00– 29.00	29.00	.....
Forging Billets, Pittsburg.....		24.00– 28.00	34.00	.....
Open Hearth Billets, Pittsburg.....		18.50– 22.50	28.00	.....
Bessemer Billets, Pittsburg.....	14.50– 30.30	19.00– 23.00	27.00	.....
Open Hearth Billets, Philadelphia.....		21.40– 25.40	30.00	.....
FINISHED STEEL, per pound:				
Refined Iron bars, Philadelphia.....	1.00– 1.90	1.27– 1.37	1.67	.....
Common Iron bars, Pittsburg.....		1.20– 1.35	1.55	.....
Common Iron bars, Chicago.....		1.15– 1.30	1.50	.....
Common Iron bars,.....	.....	.....	.....	.....
Steel bars, beams, angles, New York....		1.25– 1.56	1.75	.....

CONTINUED TO PAGE 32

CONTINUED FROM PAGE 30

	1898-1907	1911	1913	19..
Steel bars, beams, angles, Pittsburg	$ 1.30- 2.10	$ 1.10-$ 1.40	$ 1.60	.....
Steel bars, beams, angles, Chicago	.....	.....	1.75	.....
Reinforcing bars, f. o. b. Chicago	.....	.....	1.95	.....
Rivets	.....	.....	2.25	.....
Sheets, No. 10, blue, annealed, Pittsburg	.....	.....	1.65	.....
Sheets, No. 28, black, Pittsburg	.....	1.85- 2.20	2.25	.....
Sheets, No. 28, galvanized, Pittsburg	.....	.....	3.40	.....
CUT NAILS, per cwt.: Pittsburg	1.05- 2.10	1.45- 1.70	1.70	.....
	.....	.....	.....	.....
WIRE NAILS, per cwt.: Pittsburg	1.25- 2.05	1.50- 1.80	1.70	.....
	.....	.....	.....	.....
FENCE WIRE, galvanized, per cwt.: Pittsburg	.....	.....	1.90	.....
	.....	.....	.....	.....
BARBED WIRE, galvanized, per cwt.: Pittsburg	.....	1.85- 2.10	2.10	.....
	.....	.....	.....	.....
TIN PLATE, box, 14 x 20, per cwt.: New York	2.80- 4.85	3.64- 3.94	3.60	.....
COKE, Connellsville, furnace, per net ton	.....	2.90- 3.50	4.00	.....
COKE, Connellsville, foundry, per net ton	.....	3.60- 4.50	4.25	.....
CHARCOAL, per net ton	.....	.....	.....	.....

NOTE—Prices on this page and page 30 apply generally to car loads, and extra charge is usually made for prompt delivery when mills are crowded.

METAL PRICES

PER POUND

	1898-1907	1911	1913
Lake Copper, New York	11.00c-25.00c	12.45c-13.00c	17.50c
Electrolytic Copper, New York		12.25 -13.12	17.25
Spelter, New York	3.75- 7.00	5.55 - 6.95	7.35
Spelter, St. Louis		5.25 - 6.80	7.25
Lead, New York	3.60- 6.30	4.25 - 4.50	4.75
Lead, St. Louis		4.15 - 4.45	4.60
Antimony, New York		7.55 - 9.25	9.75
Pig Tin, New York	14.00- 43.00	39.55 -48.25	50.00

PER NET TON

	1913
Ferro-Manganese, 80%	$70.00
Ferro-Silicon, 50%	75.00
Ferro-Silicon, 10%	25.00
Ferro-Titanium, 15%	20.00
Mercury, per 75 lb. flask	42.00
Mesabi Range, Minnesota, Bessemer Ore, 55% iron, 10% moisture, f. o. b. Lake Erie ports, ton	4.15
Mesabi Range, Minnesota, non-Bessemer Ore, 51.5% iron, 12% moisture, f. o. b. Lake Erie ports, ton	3.40

ECONOMY TIE PLATES

ECONOMY NO. 14

This design of Rolled Steel Tie Plate seems to meet with favor where an extra high shoulder is required. We are prepared to furnish this plate either for two, three, or four-hole punching.

Above cut shows shoulder arrangement for two or four-hole punching.

Rolled 8-inch, 8 1-2-inch and 9-inch normal lengths; 5-inch, 6-inch and 7-inch widths; 3-8-inch, 7-16-inch and 1-2-inch thick.

WEIGHT OF VARIOUS SUBSTANCES

WOODS, DRY	Lbs. per Cu. ft.	Lbs. per 1000 ft. B. M.
Ash, white	38	3200
Bamboo	25	2100
Beech	42	3500
Birch	42	3500
Cedar, red	30	2500
Cedar, white	21	1800
Cherry	42	3500
Chestnut	41	3400
Cottonwood	24	2000
Cypress	30	2500
Deal	43	3500
Ebony	76	6300
Elm, red	33	2750
Elm, rock	48	4000
Fir, douglas	32	2670
Fir, balsam	25	2100
Gum, red	33	2750
Hackberry	41	3400
Hemlock	25	2100
Hickory	53	4400
Linden	27	2250
Lignum Vitae	83	6920
Locust	44	3670
Mahogany, Spanish	53	4420
Mahogany, Honduras	35	2920
Maple, hard	49	4100
Maple, soft	39	3250
Oak, live	59	4900
Oak, white	48	4000
Oak, red, black	44	3700
Pine, white	25	2100
Pine, norway	30	2500
Pine, loblolly	32	2670
Pine, longleaf, yellow	38	3200
Poplar	29	2400
Redwood, Calif	24	2000
Spruce, white	25	2100
Spruce, red	30	2500
Sycamore	38	3200
Tamarack	33	2750
Teak	40	3300
Walnut	38	3200
Willow	25	2100

NOTE—Green wood weighs from 20% to 40% more than dry.

FUEL	Lbs. per Cu. ft.
Anthracite, Pa., solid	93
Anthracite, Pa., broken, loose	54
Anthracite, Pa., broken, shaken	58
Bituminous, solid	84
Bituminous, broken, loose	50
Bituminous, broken, shaken	53
Coke, hard, solid	32
Coke, hard, broken	27
Coke, soft, solid	25
Coke, soft, broken	20
Charcoal, soft and hardwoods	15–30

METALS AND ALLOYS	Lbs. per Cu. ft.
Aluminum, wrought	166
Aluminum, cast	160
Antimony	418
Arsenic	359
Bismuth	610
Brass, cast	504
Brass, sheet	524
Brass, wire	533
Chromium	411
Cobalt	536
Copper, cast	540
Copper, sheet	555
Copper, wire	555
Gold, cast	1204
Gold, hammered	1217
Gun-metal (bronze)	530
Iron, gray cast	442
Iron, white cast	468
Iron, wrought	466–493
Iron, liquid	430
Lead	710
Manganese	462
Mercury	848
Nickel	555
Nickel, cast	517
Phosphor-bronze	537
Platinum	1342
Silver	655
Steel	490
Tin	459
Tungsten	1120
Zinc	437

LIQUIDS	Lbs. per Cu. ft.
Acid, Hydrochloric	75
Acid, Nitric	76
Acid, Sulphuric	115
Alcohol, pure	49
Alcohol, proof	57
Ether	45
Mercury	848
Milk	64
Naptha	53
Oil, petroleum	55
Oil, olive	57
Oil, linseed	59
Turpentine	54
Vinegar	67
Water, pure	62.4
Water, sea	64

Ashes, soft coal, packed	42

ECONOMY TIE PLATES

ECONOMY NO. 14

This design of Rolled Steel Tie Plate seems to meet with favor where an extra high shoulder is required. We are prepared to furnish this plate either for two, three, or four-hole punching.

Above cut shows shoulder arrangement for three-hole punching.

Rolled 8-inch, 8 1-2 inch and 9-inch normal lengths; 5-inch, 6-inch and 7-inch widths; 3-8-inch, 7-16-inch and 1-2-inch thick.

WEIGHT OF VARIOUS SUBSTANCES

STONE

	Lbs. per Cu. foot		Lbs. per Cu. foot
Asbestos	193	Gypsum	142
Basalt	150–187	Hornblende	203
Carbon	219	Limestone	162–172
Chalk	156	Marble	168–178
Chert	125–184	Marl	110
Conglomerate	156–162	Mica	183
Diabase	162–200	Quartz	165–172
Dolomite	162–178	Sandstone	150–168
Emery	249	Shale	156–165
Flint	163	Slag	125–175
Gneiss	162–200	Slate	165–175
Granite	150–170	Soapstone	170
Greenstone	187	Trap	181–193

MASONRY AND CONSTITUENTS

	Lbs. per Cu. foot
Granite or Limestone Masonry:	
Well dressed	165
Rubble, mortar	154
Rubble, dry	138
Sandstone Masonry—$\frac{1}{10}$ less than Granite.	
Brick Masonry:	
Pressed, fine joints	140
Medium quality	125
Coarse, inferior, soft	100
Concrete Masonry:	
Limestone, Gravel or Granite	148
Cinder	120
Mortar, hardened	103
Brick:	
Best, pressed	150
Common, hard	125
Soft, inferior	100
Tile—	
Cement Hydraulic:	
American, Rosendale, loose	56
American, Rosendale, well shaken	76
American, Portland, loose	88
American, Portland, well shaken	110
Lime:	
Quick, solid	95
Quick, ground, well shaken	75

Masonry and Constituents—Continued

Sand:	Lbs. per Cu. foot
Pure quartz, dry, loose	90–100
Large and small grains, dry	117
Voids full of water	118–129

Gravel:	Lbs. per Cu. Yard
Screened Gravel for Concrete	2300–2800
Ballast	
Pit Gravel	2650–3250
Washed Gravel	2400–2900

Broken Stone;

The weight of broken stone is 50% to 60% of weight of the solid stone.

Broken to pass screen with ¾″ holes and be retained on screen with ¼″ holes:	
Limestone	2500–2700
Broken to pass screen with 2″ holes and be retained on screen with ¾″ holes:	
Limestone	2200–2400
Slag, from iron ore:	
Air-cooled	2000
Granulated	1600–1800
Rip Rap	
According to kind and size of stone, and method of loading,	2550–2850

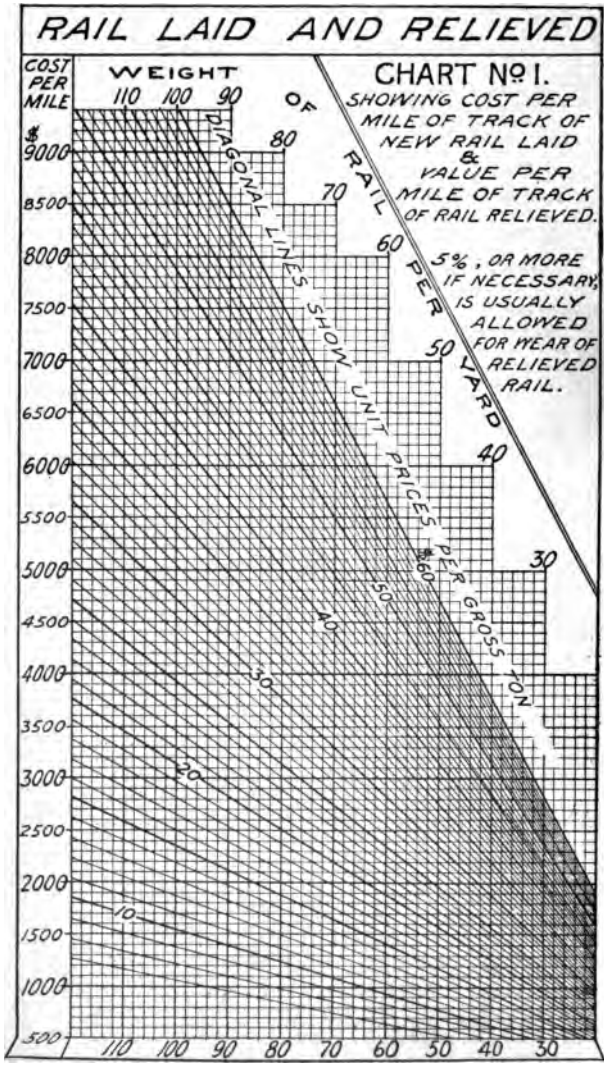
NOTE:—After train haul a cubic yard of broken stone, measured in the car, will weigh about 10% more than a cubic yard, measured in the car, at the crusher.

MISCELLANEOUS—Lbs. per cu. ft.

Air, 60° Fahren.	.0765	Tallow	59
Ice	58	Wax, bees	60
Snow, fresh fallen	5–12	Sulphur	125
Compacted by rain	15–50	Ivory	114
Asphaltum	87	Salt, coarse	45
Pitch	72	Fine	49
Rosin	69	Glass, flint	187
Tar	62	Plate	169
Rubber	58	Common	156

EARTH

Common loam, perfectly dry, loose	72–80
Common loam, perfectly dry, shaken	82–92
Common loam, perfectly dry, rammed	90–100
Common loam, slightly moist, loose	70–76
Common loam, more moist, loose	66–68
Common loam, more moist, shaken	75–90
Common loam, more moist, packed	90–100
Common loam, soft flowing mud	104–112
Common loam, soft flowing mud, pressed	110–120
Clay, potters, dry	119
Clay, dry, in lump, loose	63
Turf or peat, dry, unpressed	20–30


RAIL LAID AND RELIEVED
COST PER MILE
WEIGHT OF RAIL PER YARD
110 100 90 80 70 60 50 40 30
CHART Nº I.
SHOWING COST PER MILE OF TRACK OF NEW RAIL LAID & VALUE PER MILE OF TRACK OF RAIL RELIEVED.
5%, OR MORE IF NECESSARY, IS USUALLY ALLOWED FOR WEAR OF RELIEVED RAIL.
DIAGONAL LINES SHOW UNIT PRICES PER GROSS TON
$9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
60
50
40
30
20
10

ECONOMY TIE PLATES

ECONOMY NO. 9-R-F

ELEVATED BOSS SHOULDER PLATE FOR SCREW SPIKES

A special plate of Rolled Steel to work with screw spikes. At either end are elevated bosses with the same angle as the base of the rail. The spike-holes act as jigs when applying spikes, and the angles of the bosses absolutely prevent the spike from assuming any but a vertical position when seated. The bosses also afford reinforcement back of the head and a bearing for the flange of the screw spike not in contact with the rail base.

We can furnish this plate perfectly flat on the bottom, or with four longitudinal flanges as shown.

Rolled 8-inch, 8 1-2-inch and 9-inch lengths; 6-inch, 7-inch and 7 1-2-inch widths for 80 to 100 pounds A S C E, also for 90 and 100 pounds A R A, A or B section of rail; 3-8-inch, 7-16-inch and 1-2-inch thick.

Special plates for Guard Rails 13 inches and 15 inches *long, 6 inches,* 7 inches and 7 1-2 inches wide.

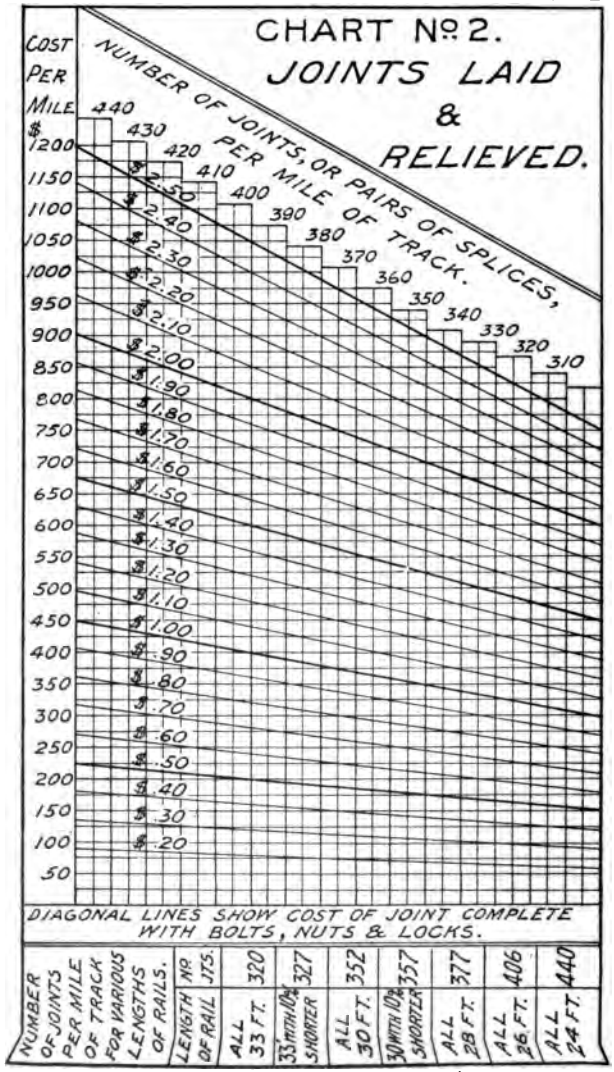
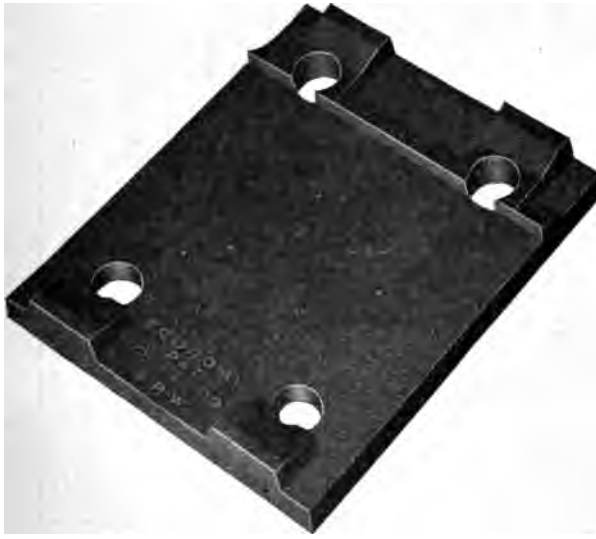


CHART Nº 2.
JOINTS LAID & RELIEVED.
NUMBER OF JOINTS, OR PAIRS OF SPLICES, PER MILE OF TRACK.
COST PER MILE
440 430 420 410 400 390 380 370 360 350 340 330 320 310
$1200 1150 1100 1050 1000 950 900 850 800 750 700 650 600 550 500 450 400 350 300 250 200 150 100 50
$2.50 2.40 2.30 2.20 2.10 2.00 1.90 1.80 1.70 1.60 1.50 1.40 1.30 1.20 1.10 1.00 .90 .80 .70 .60 .50 .40 .30 .20
DIAGONAL LINES SHOW COST OF JOINT COMPLETE WITH BOLTS, NUTS & LOCKS.
NUMBER OF JOINTS PER MILE OF TRACK FOR VARIOUS LENGTHS OF RAILS.
LENGTH OF RAIL
Nº JTS.
ALL 33 FT. 320
33 WITH 10½ SHORTER 327
ALL 30 FT. 352
30 WITH 10½ SHORTER 357
ALL 28 FT. 377
ALL 26 FT. 406
ALL 24 FT. 440

ECONOMY TIE PLATES



ECONOMY NO. 9-R-W

A special plate of Rolled Steel to work with screw spikes. At either end are elevated bosses with the same angle as the base of the rail. The spike-holes act as jigs when applying spikes, and the angles of the bosses absolutely prevent the spike from assuming any but a vertical position when seated. The bosses also afford reinforcement back of the head and a bearing for the flange of the screw spike not in contact with the rail base.

We can furnish this plate with four longitudinal flanges or perfectly flat on the bottom, as shown.

Rolled 8-inch, 8 1-2-inch and 9-inch lengths; 6-inch, 7-inch and 7 1-2-inch widths for 80 to 100 pounds A S C E, also for 90 and 100 pounds A R A, A or B section of rail, *3-8-inch, 7-16-inch* and 1-2-inch thick.

COST & VALUE OF EACH JOINT

KIND OF JOINT	LENGTH OF BAR	NO. OF BOLTS	RAIL SECTION	RAIL WGHT.	BARS COST	BOLTS COST	LOCKS COST	TOTAL. COST
Angle Bar - Bess. Steel	40 inch	6	A.S.C.E.	85	$1.30	.15	.05	$1.50
" " - O.H. "	24 "	6	A.R.A.-A.	90	.90	.15	.05	1.10
" " -Special Treat.	24 "	6	A.S.C.E.	85	1.15	.25	.10	1.50
Weber	24 "	4	A.S.C.E.	75				1.70
" -Insulated	24 "	4	A.S.C.E.	75				3.70
Bonzano	26 "	4	A.R.A.-B.	90	1.50	.10	.05	1.65
100%-O.H.-Special Treat.	26 "	4	A.R.A.-A	90	1.80	.15	.15	2.10
					RELAYING VALUE.			
Angle Bar -	40 inch	6	A.S.C.E.	85	1.00	.15	.05	1.20
Weber	24 "	4	"	75				1.50
Bonzano	26 "	4	A.R.A.-B	90	1.40	.10	.05	1.55
					SCRAP VALUE.			
Angle Bar - Steel	40 inch	6	A.S.C.E.	85	.48	.05	.01	.54
" " - "	24 "	6	A.R.A.-A.	90	.34	.05	.01	.40

ECONOMY TIE PLATES

ECONOMY NO. 9-F-W

THE ECONOMY ELEVATED BOSS SHOULDER PLATE

To meet the demand for a Tie Plate to cover greater area than heretofore we now show our Economy No. 9-F-W. Makes possible the proper application of screw spikes. Furnished with perfectly flat bottom, or with two longitudinal flanges, as shown.

Rolls ready for all sections A S C E and A R A sections A and B, 85 lb. to 100 lb. Rolled from Open Hearth Steel Billets. Made of Malleable Iron if wanted.

Rolled 8 1-2-inch, 9-inch and 9 1-2-inch lengths; 7-inch and 7 1-2-inch widths; 3-8-inch, 7-16-inch, 1-2-inch and 3-4-inch thick.

COST & VALUE OF EACH JOINT

KIND OF JOINT	LENGTH OF BAR	NO. OF BOLTS	RAIL SECTION	RAIL WGHT.	BARS	BOLTS	LOCKS	TOTAL COST.

ECONOMY TIE PLATES

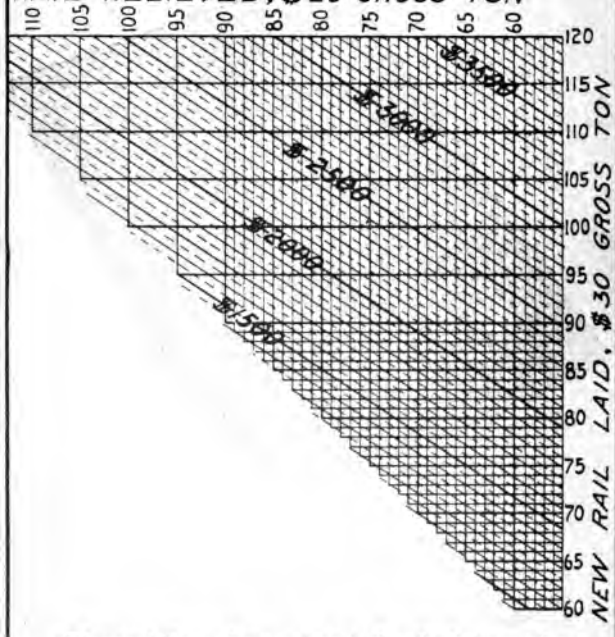
ECONOMY NO. 9-B

Another form of our Economy No. 9, Screw Spike Plate. Bosses on the shoulder end are arranged to give support to the flange of the screw spike and to reinforce same. This plate is also desirable for use with standard spikes when punched with square holes.

Rolled 8-inch, 8 1-2-inch, 9-inch and 9 1-2-inch lengths; 6-inch, 7-inch and 7 1-2-inch wide for 80 to 100 lb. A S C E Rail; 3-8-inch, 7-16-inch and 1-2-inch thick. Special Plates for Guard Rails.

CHARTS
SHOWING
NET COST OF RAIL, RELAID

CHART No. 3
WHERE NEW RAIL COSTS $30 PER G.T.
AND RELIEVED RAIL IS VALUED AT $20 G.T.



Diagonal lines show net cost of rail changes where new rail costs $30.00 per gross ton and the relieved rail is valued at $20.00 per gross ton. The diagonal lines on this chart DO NOT give correct results for ANY other combination of cost and value having same difference of $10.00 per gross ton. Two blank charts are furnished on pages 52 and 54 on which diagonal lines may be platted showing net result for other costs and values.

ECONOMY TIE PLATES

ECONOMY NO. 9-S

ELEVATED BOSS SHOULDER PLATE FOR STANDARD SPIKES

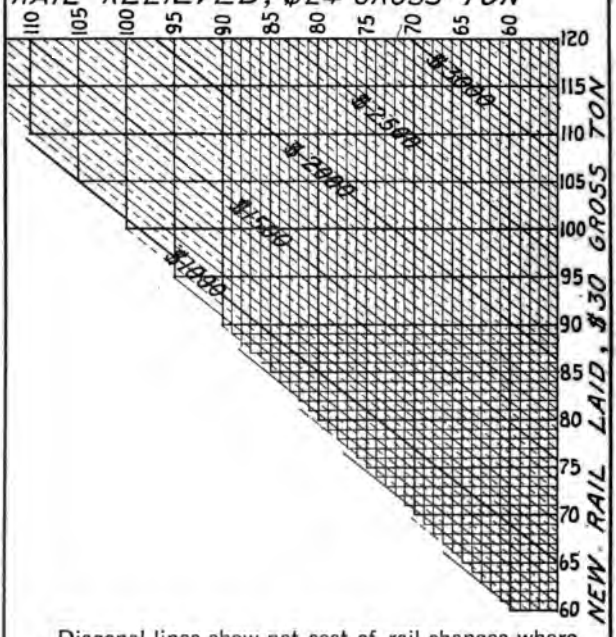
A new rolled steel Tie Plate with elevated bosses and shoulder, which, with those on the field end are so designed as to afford reinforcement back of the head and prevent bending and shearing of the standard spike.

We can furnish this plate with four longitudinal flanges or perfectly flat on the bottom if desired.

Rolled 8-inch, 8 1-2-inch and 9-inch lengths; 6-inch, 7-inch and 7 1-2-inch width for 80 lb. to 100 lb. A S C E, also for 90 and 100 lb. A R A - A or B section of rails, 3-8-inch, 7-16-inch and 1-2-inch thick.

CHARTS
SHOWING
NET COST OF RAIL, RELAID

CHART No. 4
WHERE NEW RAIL COSTS $30 PER G.T.
AND RELIEVED RAIL IS VALUED AT $24 G.T.



Diagonal lines show net cost of rail changes where new rail costs $30.00 per gross ton and the relieved rail is valued at $24.00 per gross ton. The diagonal lines on this chart DO NOT give correct results for ANY other combination of cost and value having same difference of $6.00 per gross ton. Two blank charts are furnished on pages 52 and 54 on which diagonal lines may be platted showing net result for costs and values.

ECONOMY TIE PLATES

ECONOMY NO. 9-2

A Tie Plate with all the advantages of our Economy No. 2, with the addition of bosses on the shoulder end which reinforce the standard spike, thus preventing bending and shearing. If bosses are wanted on the field end also, see our Economy No. 9-S.

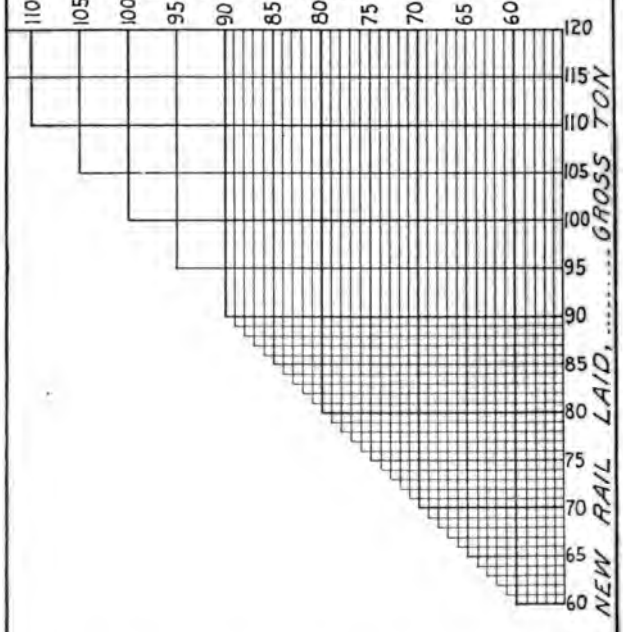
We can furnish these plates with longitudinal flanges as shown, or perfectly flat on bottom surface.

Rolled 8-inch, 8 1-2-inch or 9-inch lengths; 6-inch, 7-inch and 7 1-2-inch widths for 80 to 100 lb. A S C E Rail; 3-8-inch, 7-16-inch and 1-2-inch thick.

CHARTS
SHOWING
NET COST OF RAIL, RELAID

CHART No. 5

WHERE NEW RAIL COSTS ..... PER G.T.
AND RELIEVED RAIL IS VALUED AT ..... G.T.



Diagonal cost lines, similar to those on Charts No. 3 and No. 4, may be platted hereon, in order to obtain net results based on other costs and values of rail.

ECONOMY TIE PLATES

ECONOMY NO. 15

This design of Rolled Steel Tie Plate seems to meet with favor where an extra high shoulder is required. We are prepared to furnish this plate either for two, three, or four-hole punching. Made with solid top, if desired, and designated Economy No. 14.

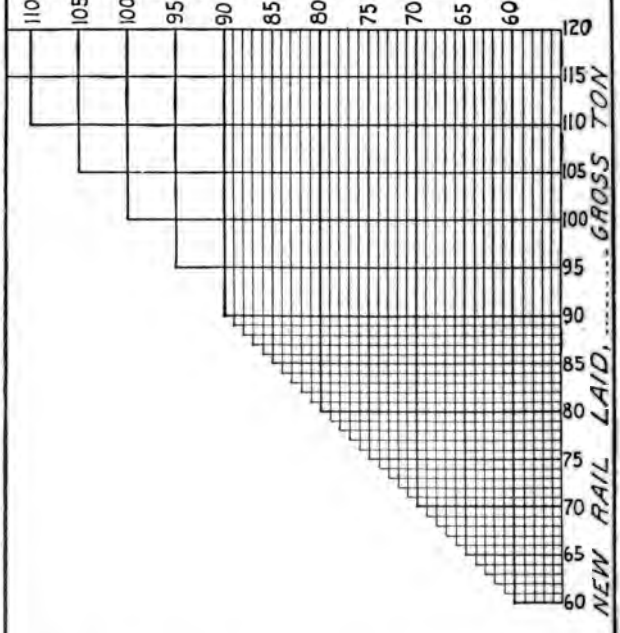
Above cut shows shoulder arrangement for three-hole punching.

Rolled 8-inch, 8 1-2-inch and 9-inch nominal lengths; 5-inch, 6-inch and 7-inch widths; 3-8-inch, 7-16-inch and 1-2-inch thick.

CHARTS
SHOWING
NET COST OF RAIL, RELAID

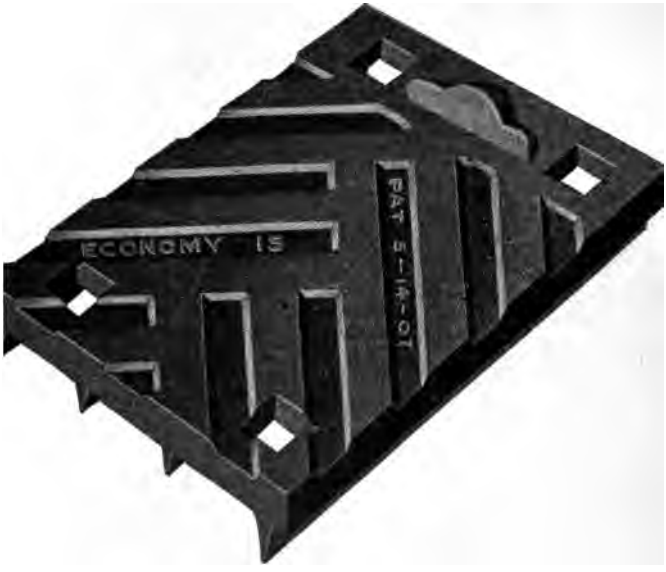
CHART No. 6

WHERE NEW RAIL COSTS ..... PER G.T.
AND RELIEVED RAIL IS VALUED AT ..... G.T.



Diagonal cost lines, similar to those on Charts No. 3 and No. 4, may be platted hereon, in order to obtain net results based on other costs and values of rail.

ECONOMY TIE PLATES



ECONOMY NO. 15-A

This design of Rolled Steel Tie Plate seems to meet with favor where an extra high shoulder is required. We are prepared to furnish this plate either for two, three, or four-hole punching. Made with solid top, if desired, and designated Economy No. 14.

Above cut shows shoulder arrangement for four-hole punching.

Rolled 8-inch, 8 1-2-inch and 9 inch nominal lengths; 5-inch, 6-inch and 7-inch widths; 3-8-inch, 7-16-inch and *1-2-inch thick.*

NET COST OF MATERIAL IN RAIL RENEWALS

RAIL WGT	SECTION	KIND	LGTH	GR TON	MILE	JOINTS KIND	LNGTH	BOLTS	EACH	MILE	TOTAL
						COST – NEW MATERIAL.					
90	A R A-A	O H	33'	$3050	$4313	SPECIAL	27"	6	$1.90	$621	$4934
75	A.S.C.E.	"	"	"	3595	ANGLE BAR	24"	4	.70	230	3825
						MARKET VALUE – RELIEVED MATERIAL.					
85	A S C E.	BESS	30'	2400	3205	ANGLE BAR	40"	6	1.20	430	3635
75	"	"	"	"	2829	"	"	"	1.15	405	3234
70	"	"	"	"	2640	"	"	"	1.10	393	3033
60	SPEC.	"	28'	"	2263	"	20	4	.50	190	2453
56	"	"	26'	"	2112	"	"	"	.45	170	2282
52	"	"	24'	"	1961	"	"	"	.40	150	2111
						BOOK VALUE – RELIEVED MATERIAL.					
85	A S C E.	BESS	30'	2000	2671	"	40"	6	1.20	430	3101
75	"	"	"	"	2357	"	"	"	1.15	405	2762
70	"	"	"	"	2200	"	"	"	1.10	393	2593
60	SPEC.	"	28'	"	1886	"	20"	4.	.50	190	2076
56	"	"	26'	"	1760	"	"	"	.45	170	1930
52	"	"	24'	"	1634	"	"	"	.40	150	1784

ECONOMY TIE PLATES

ECONOMY NO. 12

THE ECONOMY ROLLED STEEL TRANSVERSE FLANGE TIE PLATE

A strong plate materially reduced in weight. Note the area of rail bearing surface as compared with other plates of like character. The transverse flanges furnish adhesion to the tie and will prevent spreading of the rails. Furnished without flanges, if desired.

Rolled in 8-inch, 9-inch and 9 1-2-inch lengths and to widths 5 inches to 8 inches; 7-16-inch, 1-2-inch or thicker *if wanted.*

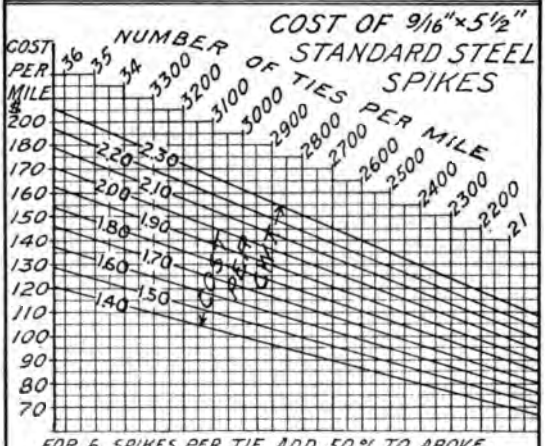
NET COST OF MATERIAL
IN RAIL RENEWALS
RAIL
WGT. SECTION KIND LGTH GR TON MILE
JOINTS
KIND LGTH. BOLTS EACH MILE
TOTAL
COST — NEW MATERIAL.
MARKET VALUE — RELIEVED MATERIAL.
BOOK VALUE — RELIEVED MATERIAL.

ECONOMY TIE PLATES

ECONOMY NO. 20

If flat plates—bottom and top—are wanted, we make them of Open Hearth Steel, any length, width and thickness desired. Punched with either round, square or elliptical holes as wanted. We have special facilities for *doing this work.*

SPIKES



FOR 6 SPIKES PER TIE ADD 50% TO ABOVE,
" 8 " " " MULTIPLY BY TWO.

NET VALUES

IN RE-LAYING RAIL SPIKES ARE USUALLY HANDLED AS FOLLOWS:-

a. PULL 4 LINES (OR ALL) OF SPIKES,
b. " 3 " (" 3/4) " "
c. " 2 " (" 1/2) " "

SCRAP VALUE OF SPIKES IS ABOUT 4/10 NEW VALUE, AND IN ADDITION DEDUCT 10% FOR LOSS.

WHEN RELIEVED SPIKES ARE SOLD SCRAP VALUE IS
IN CASE a. 3/10 OF VALUE SHOWN IN CHART. (1)
" " b. 2/10 " " " " " (2)
" " c. 1/10 " " " " " (3)

IN ABOVE CASES NEW SPIKES MUST BE BOUGHT FOR SPIKING RELIEVED RAIL; THEIR COST WILL BE TAKEN FROM CHART; AND DEDUCTING SCRAP VALUE AS SHOWN IN (1), (2) OR (3) WILL GIVE NET COST.

WHERE RELIEVED SPIKES ARE USED IN SPIKING RAIL THE NET COST OF SPIKES WOULD BE
IN CASE a. 0
" b. 1/4 TOTAL COST SHOWN BY CHART,
" c. 1/2 " " " "

IN CASES WHERE ONLY THE BEST OF THE OLD SPIKES ARE USED AND THE BALANCE SOLD FOR SCRAP, THE NET VALUE MUST BE COMPUTED FOR EACH CASE.

WHERE SCREW SPIKES ARE USED, ALLOW 4 PER TIE, AT 3¢ EACH = 12¢ PER TIE.

WHERE TIE PLATES ARE USED, ALLOW 2 PER TIE, AT 15¢ EACH = 30¢ PER TIE.

ECONOMY TIE PLATES

ECONOMY NO. 9-R

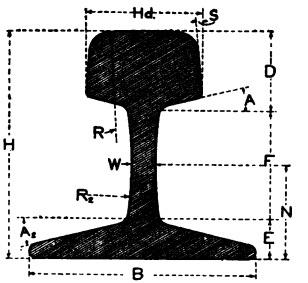
A special plate of Rolled Steel to work with screw spikes. At either end are elevated bosses with the same angle as the base of the rail. The spike holes act as jigs when applying spikes, and the angles of the bosses absolutely prevent the spike from assuming any but a vertical position when seated. The bosses also afford reinforcement back of the head and a bearing for the flange of the screw spike not in contact with the rail base.

We can furnish this plate perfectly flat on the bottom, or with four longitudinal flanges.

Rolled 8-inch, 8 1-2-inch and 9-inch lengths; 6-inch, 7-inch and 7 1-2-inch widths for 80 to 100 pounds A S C E, also for 90 and 100 pounds A R A, A or B section of rail; 3-8-inch, 7-16-inch and 1-2-inch thick, or thicker, if *wanted.*

H - Height.
B - Base.
Hd. Head.
D - Depth of Head.
F - Fishing Height.
E - Depth of Base.
W- Width of Web.

A - Upper Fishing Angle.
A_2 Lower Fishing Angle.
S - Slope of Head.
N - Center of Web.
R - Radius, Top of Head.
R_2 Radius of Web.
Dimensions in Inches.



STANDARD RAIL SECTIONS
DIMENSIONS AND PROPERTIES

TYPE	Wt.	Ill.St. No.	H	B	Hd.	D	F	E	W	A	A_2	S	N	R	R_2
A.S.C.E.	100	10001	$5^3/_4$	$5^3/_4$	$2^3/_4$	$1^{45}/_{64}$	$3^5/_{64}$	$^{31}/_{32}$	$^9/_{16}$	13°	13°	Str.	$2^{65}/_{128}$	12	12
"	90	9002	$5^3/_8$	$5^3/_8$	$2^5/_8$	$1^{19}/_{32}$	$2^{55}/_{64}$	$^{59}/_{64}$	$^9/_{16}$	"	"	"	$2^{45}/_{128}$	"	"
"	85	8504	$5^3/_{16}$	$5^3/_{16}$	$2^9/_{16}$	$1^{35}/_{64}$	$2^3/_4$	$^{57}/_{64}$	$^9/_{16}$	"	"	"	$2^{17}/_{64}$	"	"
"	80	8004	5	5	$2^1/_2$	$1^1/_2$	$2^5/_8$	$^7/_8$	$^{35}/_{64}$	"	"	"	$2^3/_{16}$	"	"
"	75	7506	$4^{13}/_{16}$	$4^{13}/_{16}$	$2^{15}/_{32}$	$1^{27}/_{64}$	$2^{35}/_{64}$	$^{27}/_{32}$	$^{17}/_{32}$	"	"	"	$2^{15}/_{128}$	"	"
"	70	7010	$4^5/_8$	$4^5/_8$	$2^7/_{16}$	$1^{11}/_{32}$	$2^{15}/_{32}$	$^{13}/_{16}$	$^{33}/_{64}$	"	"	"	$2^3/_{64}$	"	"
"	65	6507	$4^7/_{16}$	$4^7/_{16}$	$2^{13}/_{32}$	$1^9/_{32}$	$2^3/_8$	$^{25}/_{22}$	$^1/_2$	"	"	"	$1^{31}/_{32}$	"	"
"	60	6015	$4^1/_4$	$4^1/_4$	$2^3/_8$	$1^7/_{32}$	$2^{17}/_{64}$	$^{49}/_{64}$	$^{31}/_{64}$	"	"	"	$1^{115}/_{128}$	"	"
A.R.A.-A.	100	10020	6	$5^1/_2$	$2^3/_4$	$1^9/_{16}$	$3^3/_8$	$1^1/_{16}$	$^9/_{16}$	4 to 1	4 to 1	$^1/_{16}$ to 1	$2^3/_4$	14	14

A.R.A.-A.	90	9020	$5\frac{5}{8}$	$5\frac{1}{8}$	$2\frac{9}{16}$	$1\frac{15}{32}$	$3\frac{5}{32}$	1	$\frac{9}{16}$	4 to 1	4 to 1	$\frac{1}{16}$ to 1	$2\frac{37}{64}$	14	14
"	80	8020	$5\frac{1}{8}$	$4\frac{5}{8}$	$2\frac{1}{2}$	$1\frac{7}{16}$	$2\frac{23}{32}$	$\frac{31}{32}$	$\frac{33}{64}$	"	"	"	$2\frac{21}{64}$	"	"
"	70	7020	$4\frac{3}{4}$	$4\frac{1}{4}$	$2\frac{3}{8}$	$1\frac{11}{32}$	$2\frac{1}{2}$	$\frac{29}{32}$	$\frac{1}{2}$	"	"	"	$2\frac{5}{32}$	"	"
"	60	6020	$4\frac{1}{2}$	4	$2\frac{1}{4}$	$1\frac{15}{64}$	$2\frac{29}{64}$	$\frac{13}{16}$	$\frac{15}{32}$	"	"	"	$2\frac{5}{128}$	"	"
A.R.A.-B.	100	10030	$5\frac{41}{64}$	$5\frac{9}{64}$	$2\frac{21}{32}$	$1\frac{45}{64}$	$2\frac{55}{64}$	$1\frac{5}{64}$	$\frac{9}{16}$	13°	13°	3°	$2\frac{65}{128}$	12	12
"	90	9030	$5\frac{17}{64}$	$4\frac{49}{64}$	$2\frac{9}{16}$	$1\frac{39}{64}$	$2\frac{5}{8}$	$1\frac{1}{32}$	$\frac{9}{16}$	"	"	"	$2\frac{11}{32}$	"	"
"	80	8030	$4\frac{15}{16}$	$4\frac{7}{16}$	$2\frac{7}{16}$	$1\frac{15}{32}$	$2\frac{15}{32}$	1	$\frac{35}{64}$	"	"	"	$2\frac{15}{64}$	"	"
"	70	7030	$4\frac{35}{64}$	$4\frac{3}{64}$	$2\frac{3}{8}$	$1\frac{23}{64}$	$2\frac{17}{64}$	$\frac{59}{64}$	$\frac{33}{64}$	"	"	"	$2\frac{7}{128}$	"	"
"	60	6030	$4\frac{3}{16}$	$3\frac{11}{16}$	$2\frac{1}{8}$	$1\frac{1}{4}$	$2\frac{1}{16}$	$\frac{7}{8}$	$\frac{31}{64}$	"	"	"	$1\frac{29}{32}$	"	"
P.S.-Penn	100	10031	$5\frac{11}{16}$	5	$2\frac{43}{64}$	$1\frac{13}{16}$	$2\frac{25}{32}$	$1\frac{3}{32}$	$\frac{9}{16}$	15°	"	$\frac{3}{32}$ to 1	$2\frac{31}{64}$	10	10
"	85	8530	$5\frac{1}{8}$	$4\frac{5}{8}$	$2\frac{1}{2}$	$1\frac{21}{32}$	$2\frac{15}{32}$	1	$\frac{17}{32}$	"	"	Str.	$2\frac{15}{64}$	"	"
P.R.R.	100	Cam520	$5\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{13}{16}$	$1\frac{7}{8}$	$2\frac{11}{16}$	$\frac{15}{16}$	$\frac{5}{8}$	13°	"	4°	$2\frac{9}{32}$	"	8
"	85	8503	5	5	$2\frac{9}{16}$	$1\frac{3}{4}$	$2\frac{3}{8}$	$\frac{7}{8}$	$\frac{17}{32}$	"	"	"	$2\frac{1}{16}$	"	"
"	70	7005	$4\frac{1}{2}$	$4\frac{1}{2}$	$2\frac{7}{16}$	$1\frac{19}{32}$	$2\frac{1}{8}$	$\frac{25}{32}$	$\frac{1}{2}$	"	"	"	$1\frac{27}{32}$	"	"
"	60	6001	$4\frac{1}{4}$	$4\frac{1}{16}$	$2\frac{5}{16}$	$1\frac{7}{16}$	$2\frac{1}{8}$	$\frac{11}{16}$	$\frac{1}{2}$	14°	12° 50	$\frac{1}{10}$ to 1	$1\frac{3}{4}$	"	12
Grt.Nor.	90	9010	$5\frac{3}{8}$	5	$2\frac{5}{8}$	$1\frac{1}{2}$	$2\frac{7}{8}$	1	$\frac{5}{8}$	13°	13°	5°	$2\frac{7}{16}$	14	14
"	85	8509	5	5	$2\frac{21}{32}$	$1\frac{19}{32}$	$2\frac{1}{2}$	$\frac{29}{32}$	$\frac{21}{32}$	14°	14°	"	$2\frac{5}{32}$	12	12
"	80	8009	5	5	$2\frac{13}{32}$	$1\frac{5}{8}$	$2\frac{1}{2}$	$\frac{7}{8}$	$\frac{5}{8}$	"	"	"	$2\frac{1}{8}$	10	"
U.P.	90	9003	$5\frac{3}{4}$	$5\frac{3}{8}$	$2\frac{3}{4}$	$1\frac{1}{2}$	$3\frac{3}{8}$	$\frac{7}{8}$	$\frac{17}{32}$	13°	13°	Str.	$2\frac{9}{16}$	12	"
"	75	7513	5	5	$2\frac{9}{16}$	$1\frac{3}{8}$	$2\frac{13}{16}$	$\frac{13}{16}$	$\frac{33}{64}$	"	"	"	$2\frac{1}{4}$	"	"
C.&N.W.	72	7201	$4\frac{3}{4}$	$4\frac{3}{4}$	$2\frac{3}{8}$	$1\frac{13}{32}$	$2\frac{1}{2}$	$\frac{27}{32}$	$\frac{9}{16}$	14°	14°	"	$2\frac{3}{32}$	"	"
C.B.&Q.	85	8506	$5\frac{3}{16}$	$5\frac{3}{16}$	$2\frac{21}{32}$	$1\frac{35}{64}$	$2\frac{3}{4}$	$\frac{57}{64}$	$\frac{9}{16}$	13°	13°	5°	$2\frac{17}{64}$	"	"

APPROXIMATE FREIGHT RATES

Car Load Rate Per GROSS TON on RAIL AND FASTENINGS			Car Load Rate Per 100 LBS. on STRUCTURAL STEEL			
FROM			FROM			TO
Pitts-burg	Chicago	Bir-mingham	Pitts-burg	Chicago	Bir-mingham	
$ 2.30	$ 4.30	$ 5.65	$ 0.14½	$0.27	$0.41	Baltimore
11.00	6.75	.....	.38	.30	.....	Birmingham
3.00	5.10	.....	.18	.33	.....	Boston
1.65	2.80	.....	.11	.18	.....	Buffalo
4.00	.....	5.65	.18	.....	.37	Chicago
2.90	2.00	3.75	.13	.....	.27	Cincinnati
2.25	.....	.....	.....	.....	.....	Cleveland
19.00	6.00	10.00	.95	.77	1.05	Denver
3.80	1.60	5.20	.....	.11½	.35	Indianapolis
9.50	2.75	6.60	.52½	.27	.56	Kansas City
6.60	4.00	2.85	.27½	.18	.23	Memphis
7.20	5.60	3.25	.47	.25	.23	New Orleans
2.60	4.70	7.45	.16	.30	.42	New York
9.50	2.75	6.60	.44½	.27	.56	Omaha
.....	2.80	.....	.....	.18	.....	Pittsburg
2.40	4.30	6.55	.15	.28	.42	Philadelphia
5.00	1.60	4.85	.22½	.9	.34	St. Louis
7.15	1.75	9.60	.36½	.14	.53	St. Paul
20.00	39.00	40.00	1.85	1.75	1.80	Pacific Coast
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....

NOTE—Rates on fastenings are the same per 100 lbs. as on rail but are *quoted in tariffs per net ton.* Rates in reverse direction are not always same.

ECONOMY TIE PLATES

ECONOMY NO. 3-A

Economy Shoulder Tie Plate with flat top and bottom surface. Rolled 8″, 8½″ and 9″ long; 5″, 6″, 7″, 8″ and 8½″ wide; $\frac{7}{16}$″, ½″ or thicker if wanted. Made from Open Hearth Steel.

ECONOMY TIE PLATES

ECONOMY NO. 3-B

Economy Shoulder Tie Plate with flat top surface and provided with two depending transverse flanges on its bottom surface to give the plate adhesion to the tie, thus minimizing spike wear. Rolled 8″, 8½″ and 9″ long; 5″, 6″, 7″, 8″ and 8½″ wide; $\frac{7}{16}$″, ½″ or thicker if wanted. Made from Open Hearth Steel.

ECONOMY TIE PLATES

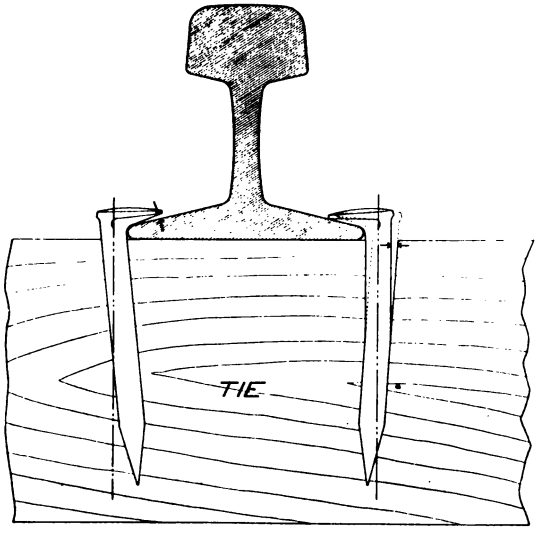
ECONOMY NO. 3-C

Economy Shoulder Tie Plate with flat top surface and provided with four depending transverse flanges on its bottom surface, giving the plate greater adhesion on oak and other hard wood ties. Rolled 8″, 8½″ and 9″ long; 5″, 6″, 7″, 8″ and 8½″ wide; $\frac{7}{16}$″, ½″ or thicker if wanted. Made from Open Hearth Steel.

Section Two

Data and Information in Regard to Spikes

SQUARE SPIKES IMPERFECTLY DRIVEN



IMPROPERLY DRIVEN SPIKES

The head of a common square spike is so shaped that when it is driven in a vertical position the underside of the head conforms to the surface of the base of the rail.

The above spikes are not driven vertically, as is seen by comparing them with the vertical dotted lines.

The spike on the left hand extends under the rail, and the arrows indicate the imperfect contact on the rail base.

The spike on the right as originally driven, (see dotted outline) did not touch the rail. It was then struck on the back until the head bears against the rail. The *opening behind the* head decreases its resistance against *side pressure,* and admits water to cause decay.

THE FUNCTION OF A SPIKE

The functions of a spike are, first: to hold the rail to the tie, and second, to prevent the rail from spreading laterally.

For hard wood ties where the wearing action of the rail on the tie is not so excessive, the holding of the rail to the tie is of less importance than for softer timber. The life of the tie depends on the elimination of the movement of the rail on the tie, with the resulting wear. Prevention of the rail from spreading laterally means the prevention of at least 25% of the accidents of railroading. The best spike therefore is that form of spike which most perfectly binds the rail to the tie and most perfectly prevents lateral movement of the rail on the tie. It is a well known fact that each pair of wheels on an engine or the cars that it hauls causes what is known as wave action, which tends to exert upward pressure on the head of the spike.

SPIKES IN SOFT WOOD

The present method or practice on American railways of spiking the rail to the tie has proven very unsatisfactory, and has long been recognized as open to improvement, especially in connection with the present soft woods now coming into general use. These soft woods have an open coarse fibrous grain which offers a very small factor of adhesion between the spike and the tie, and these adhesive qualities are still further reduced after the spike has been withdrawn and driven back in the same hole, or after the hole has been plugged. The result is that the rail is not firmly held in contact with the tie, thus permitting the rail to creep or run, and creating an abrasion or mechanical wear upon the tie which greatly shortens its life. Furthermore the constant lateral thrust *exerted against* the rail has a tendency to loosen or bend *the spike away* from the rails compressing and tearing

Showing the breaking down of the fibre by the use *of the common* spike.

the fibre of the tie so that an opening is formed between the spike and tie which allows moisture to seep in and start decay. This frequently necessitates respiking from time to time with the result of ultimately spike killing the tie.

SPIKES IN HARD WOOD

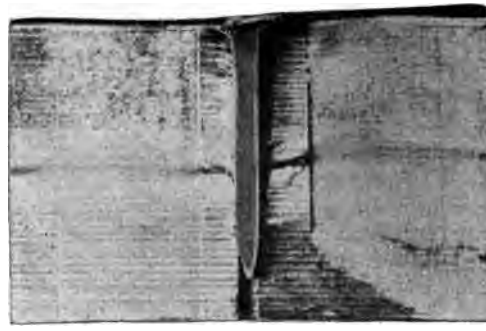
Where hardwood ties are used, the mechanical wear on the tie is somewhat reduced. The undulatory or wave action of the rail serves as a vertical lifting factor on the common spike. This action takes place in hardwood and softwood ties alike, and the efficiency of the spike, both against vertical and lateral stresses, is materially reduced.

It has been suggested, as an experiment, that if a hole be first bored in the tie, and the spike driven into it, the fibres would sustain less injury than by the old method of driving the spike without either first boring a hole or using of some form of a guide that would serve to hold the spike in a vertical position.

SPIKE TESTS

To ascertain the value of this idea, a series of tests were made by J. A. Newlen, in charge of Timber Tests Forest Products Laboratory; ordinary 9-16-inch square spikes were driven into Red Oak Ties previously bored with holes 3-8-inch, 7-16-inch, and 1-2-inch in diameter, and although the spikes were driven by an experienced trackman, but without tie plates, in over half the cases they failed to follow the holes. Their resistance to pulling was thus reduced.

It was found that when no hole was bored, the average force required to pull the spikes was 8827 lbs., and when *bored as above* described, the respective forces were *8050, 8106,* and 7154 lbs.



Showing condition of driven spikes in tie where hole *is first bored and* without boring.

In order to overcome the trouble experienced in driving a wedge-shaped spike into the bored hole, some spikes were pointed on four sides, and it was found that these could be driven to follow the bored hole without difficulty, and that their resistance to withdrawal was increased, and the wood fibres neither torn nor seriously injured.

Further tests showed the number of pounds required to pull spikes from Red Oak Ties was as follows:

Ordinary 9/16-inch square spike driven without boring.....7613 lbs.

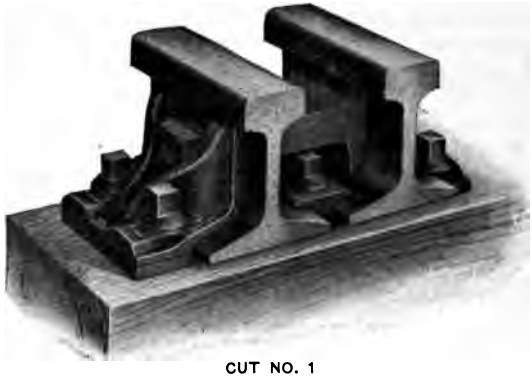
Ordinary 9/16-inch square spike pointed four sides driven in ⅜-inch holes.....8178 lbs.

Ordinary 9/16-inch square spike pointed four sides driven in 7/16-inch holes.....7856 lbs.

Ordinary 9/16-inch square spike pointed four sides driven in ½-inch holes.....7664 lbs.

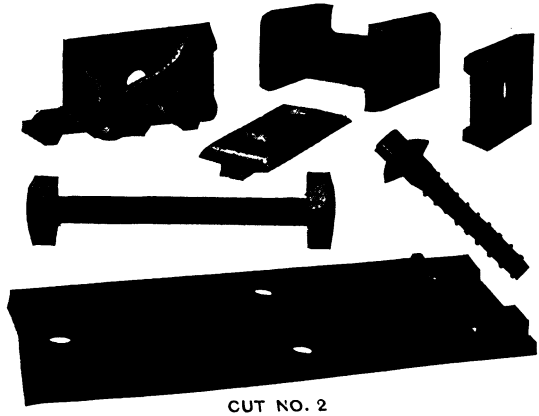
When the diamond pointed spikes were driven into the tie without first boring holes the ties invariably split.

The undulatory movement of the rail, which lifts the common spike out of the cross tie, and to which attention has already been drawn, emphasizes another serious draw-back to the use of common spikes. In order to keep the rail firmly seated on the tie, the spikes must be re-driven, and the fibres of the tie are so injured thereby that the re-driven spike loses a large percentage of its vertical holding power.

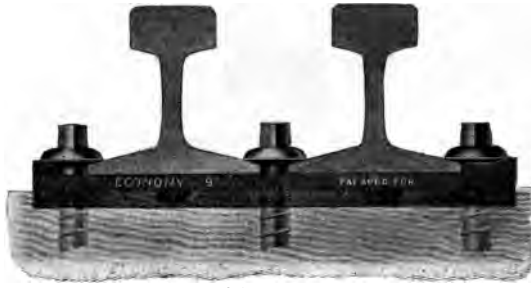


CUT NO. 1

A glance at the cuts show a complete and rigid construction. All of the screw spike fastenings are entirely out of contact from rail abrasion on the shank or throat. The design of the rail brace as shown in the assembling parts is so constructed that it interlocks with the tie plate by means of a dowel shown on the bottom surface—a feature that materially assists in relieving the strain from transverse movement on the spikes by the rail.



CUT NO. 2



CUT NO 3

A special rolled steel tie plate designed for guard rails on bridge decks, interlocking plants and similar conditions. A glance at cut No. 1 clearly shows its construction. Cut No. 2 shows the assembling parts. Cut No. 3 shows a combination with the assembling parts eliminated except the screw spikes.

The construction shown in plate No. 1 is so arranged that an absolute bond is created between the tie plate and the rails which entirely eliminates any abrasion by the movement of the rails on the screw spikes. The shoulder end of the plate protects the screw spikes from abrasion. The clip used between the rails not only assists in maintaining the rails in the proper position but prevents any abrasion on the screw spikes. On the field end of the tie plate the rail brace is shown by being interlocked with the tie plate by the introduction of a small dowel on the bottom of the brace with holes arranged for the screw spikes which does not in any way come in contact with the rail. The combination is then locked together by a spreader with a bolt of sufficient dimensions passing between the two rails which makes an absolute bond, preventing any movement of the rails laterally.

Cut No. 3 shows the assembling of same plate without a number of the features as shown in Cut No. 1 and is securely fastened by six screw spikes to the tie. The feature of this combination is the absolute vertical position of the screw spikes which are held in place by the *bosses on either* end and the rail flange for the two *center spikes.*

Showing the perfect application of the screw spike in *the tie—the fibre* intact.

The following table illustrates the decrease in holding power for re-driven spikes in hard wood. In soft wood a re-driven spike has not sufficient holding power to give any data of value.

Gum.	Decreased	in	resistance	.....18 %
Poplar	"	"	"	.....19 %
Ash	"	"	"	.....25 %
Red Oak	"	"	"	.....35 %
Elm	"	"	"	.....39 %

We have found in the field that not enough attention has been given to preparing a uniform bearing for the rail on the tie, and when not properly surfaced, the rail has an uneven bearing which tends to throw the rail out of alignment, and at the same time start mechanical wear of the tie.

As a solution for the proper application of square spikes to the tie, and with the assurance that they are to be properly applied, the Spencer Otis Company offer their No. 9 Economy Rolled Steel Tie Plates, punched with extreme accuracy to fit the rail base and the spike. The holes through the plate form a guide for the spike, which can be driven home without the necessity of employing an experienced spiker, and forms perfect contact with the tie plate and rail.

AVERAGE HOLDING POWER (IN POUNDS) OF DIFFERENT FORMS OF SPIKES IN DIFFERENT WOODS

	Common Spike	SCREW SPIKES			
	9/16"	9/16" Cut Thread	9/16" Rol. Thread	5/8" Rol. Thread	5/8" Rol. Thread French
Loblolly Pine, Treated..... Specimen No. 1	2448	8455	8854	9958	8010
Loblolly Pine, Untreated... Specimen No. 1	2783	7976	7921	8376	7836
Spruce.....	3080	8606	8116	9200	8040
Loblolly Pine, Treated..... Specimen No. 1	3765	11407	9927	10607	9875
Loblolly Pine . Untreated..... Specimen No. 2	4980 3923	10785	10090	9740	11430
Fir.....	4130	9214	8893	9287	9106
Red Oak..... Treated.....	6325 6751	12420	12970	10715	12450
Oak.....	8060	12600	12610	13690	12660
White Oak. ... Untreated.....	9228 9336	13200	11900	13550	13530
Nara.....	7665	12416	12640	.....	12070
Ohio Lehua...	8340	12855	12255	13960	13240

Careful consideration of the table on the opposite page will afford conclusive evidence of the relative values of ordinary cut spikes and screw spikes for preventing the objectionable results to which attention is drawn in the preceding pages.

The table is prepared from tests made with the greatest care and each figure is the average of a sufficient number of tests to make the table representative and to allow accurate conclusions to be drawn. It will be seen from a comparison of the results that the holding power of the screw spike is from 1½ to 4 times that of the common spike.

The use of pine, cedar, and other soft woods for cross ties is rapidly extending, and the use of a fastening better than the common spike is becoming still more imperative. The table on the opposite page shows the relative value of the ordinary cut spike compared with the screw spike, and conclusions can only be drawn in favor of the latter. Summing up all the facts in the case, it would seem that the screw spike must be recognized as an ideal solution of the various economical problems arising in connection with rail and tie renewals, and track maintenance, and being confronted by these facts so vividly, it would seem that the screw spike would recommend itself without further comment as an ideal solution.

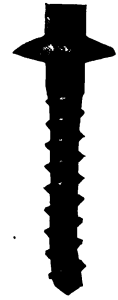
COST OF SCREW SPIKE INSTALLATION

Using modern apparatus, it has been found that a crew of one foreman and four laborers, averaging $8.00 a day for the entire crew can bore the holes for, and drive 1500 screw spikes in one day at an average cost of one-half cent per screw spike.

While some railroads in America are adopting the screw spike wholly, a large number are now using them entirely on their bridges, where it is found that they hold remarkably well, gauge is maintained in good condition, and maintenance cost materially reduced.

Records have been kept of taking up old track and relaying with screw spikes and tie plates, and on some bridges, under very adverse conditions, it has been found that the total cost of labor of pulling old spikes, plugging hole, boring hole for screw spike, adzing and applying plates, lining and applying screw spikes per mile of single track bridge was $175.00.

Similar records show that in laying rail, ties can be bored and screw spikes driven for a labor cost of not to exceed $50.00 per mile.



As with proper apparatus for boring ties and driving screw spikes, the cost of labor in installation can be materially reduced, some space is given to the description of such devices.

Greenlee Geared Ratchet Screw Spike Driver

For Fast Work in the Hardest Woods

Also Detachable Handle T - Wrenches

Greenlee Bros. & Co.

Chicago and Rockford, Ill.

THE
GREENLEE SYSTEM
OF
ADZING AND BORING RAILROAD TIES

SAVES RAIL BREAKAGE because it provides a perfect bearing on every tie.

SAVES RAIL CUTTING because it insures close contact between the rails and ties.

SAVES SPIKE KILLING because the spikes have greater resistance to vertical pull and flange pressure and the necessity of re-driving is greatly reduced.

SAVES TIE DECAY because, when done before treatment, the vital parts of the ties are thoroughly saturated with the chemical.

SAVES MONEY because the life of ties is increased two to three years at a cost of less than one per cent per tie per year of added life.

AUTOMATIC MACHINES—SIX TIES PER MINUTE

GREENLEE BROS. & CO.
Chicago and Rockford
Illinois

Section Three

Tie Plates

THE PROPERLY DESIGNED TIE PLATE

Very little has been said up to this point on the subject of tie plates. A properly designed tie plate will go far toward eliminating modern track troubles, and used with a properly designed screw spike, forms the ideal method of securing rails to ties.

First: A tie plate in a large measure insures that the spike is driven properly into the tie.

Second: It provides a uniform bearing surface for the rail and distributes the pressure of the rail over a sufficient area on the tie to insure adequate support.

Third: It presents a positive shoulder to the rail flange and eliminates the possibility of rail spreading.

Fourth: It protects the tie from mechanical wear—moisture and the resulting decay.

SHOWING OF APPLICATION OF SCREW SPIKES TO *ECONOMY* NO. 9 TYPE OF TIE PLATE

ECONOMY IN THE USE OF TIE PLATES

That large economies result from the use of tie plates is now freely admitted and experienced users thereof have proven to their entire satisfaction that a great saving in tie and rail renewals has been made by the proper application of a well designed tie plate, besides showing very satisfactory reduction in ordinary maintenance expense.

To produce these much-to-be desired results too much care cannot be exercised to insure, first: the selection of a tie plate of dimensions proportionate to meet the conditions; second: the proper preparation of the tie; and third: the proper application to both tie and rail.

Little thought or attention apparently has been given by some tie plate users to the necessity for obtaining a plate of such material and dimensions as would best serve the conditions, and more serious consideration must be given these features in the case of soft wood than hardwood ties.

A tie plate to be used on a tie of oak, or pine, cedar and similar soft woods should have the greatest area of bearing surface that the tie affords, for protection against mechanical wear or abrasion.

Tests made at Purdue University by Professor Hatt to determine the compressive strength of various kinds of ties gave the following results. The average stress under the rail bearing at the elastic limit was found to be:

For untreated red oak.....1131 lbs. per square inch
For untreated loblolly pine . 578 lbs. per square inch
For shortleaf pine..... 642 lbs. per square inch
For longleaf pine..... 690 lbs. per square inch
For red gum..... 830 lbs. per square inch

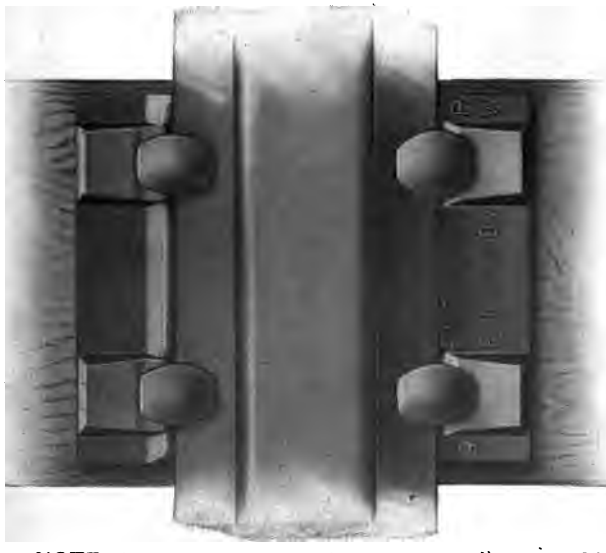
These tests show clearly the necessity for using with any tie a plate having a bearing surface proportionate to the area of tie to be used.

The proper direction for the distribution of the tie plate over the tie should be seriously considered to avoid if possible, especially on soft wood ties, the forming of a four sided pocket surrounding the tie plate after it has been some time in service and has finally imbedded itself so that the top surface of the plate is on the same plane as the surface of the tie. Such a condition forms a receptacle for moisture with no possible chance for drainage, and decay takes place immediately with the result that the tie is weakened directly under the rail where the strength should be greatest. These conditions can be lessened very materially by extending the tie plate entirely over the tie width, thus avoiding the four sided pocket formation, and giving the moisture an opportunity to drain from under the plate toward the sides of the ties. A sufficient distance should be allowed on the tie plate outside the rail base to properly secure a firm backing up for the spike and have, if possible, the head so protected that train derailments will not shear or otherwise mutilate the spike to destruction, and allowing the rail to roll from its regular position.

Our No. 9 S Plate (See page opposite) is designed to meet this condition. Derailments, that have occurred where it has been used, have been confined to the one car as the spikes and plate held the rail firmly in position and no other wheels left the track. The tread of the wheel of car, when derailed, engages the bosses on the tie plate and the spike thus escapes injury.

The arrangement of the shoulder on plates of this type is so designed that there is absolutely no contact between the throat of the spike and the base of the rail when in place on the tie. With this feature it entirely eliminates the throat cutting effect of the square or cut spike on the shoulder side of the tie plate from the longitudinal or transverse movement of the rail. It does not affect the bond between the spike and rail. It also re-enforces the head of the spike preventing any bending action. The hole through the bosses forms a guide for the applying of the spike, holding it in a vertical position when driving.

ECONOMY No. 9 R W TYPE SCREW SPIKE TIE PLATES



NOTE: *See page 70 showing square spikes imperfectly driven. See page 91 for illustration of tie plate showing shoulder and boss arrangement.*

Screw spikes driven through a tie plate without any reinforcing boss or support for the head of the screw spike.

NOTE how the screw spikes are bent in the tie by the lateral thrust of the rail after three years' service.

Economy No. 9 Type of Tie Plate absolutely prevents *such conditions.*

Result of using a small narrow tie plate in a soft wood tie.

NOTE the buckling of the plate and the crushing of the wood fibres.

Wooden Tie Plate crushed into a green hemlock tie after three years' service.

Wooden Tie Plates have been used experimentally by the A. T. & S. F. Ry., C. & N. W. Ry., and Northern Pacific Ry. The plates were made of creosoted oak and maple about 5-8-inch thick, 8 inches long and as wide as the base of the rail. They were placed between the rail and the tie without any previous adzing, the common practice abroad. The results were very unsatisfactory. *The plates split* badly and frequently became loose or *displaced and in* some cases they embedded themselves *in the tie.*

ECONOMY NO. 9 R W ROLLED STEEL TIE PLATE
FOR SCREW SPIKES

NOTE the arrangement of the bosses on the shoulder end of the Plate. The shoulder is advanced AHEAD of the bosses. This arrangement prevents the throat of the spike from abrasion or cutting effect of the rail travel or transverse thrust—there being no contact between the throat or shank of the spike and the rail.

See page 91 for illustrations showing plan and elevation of No. 9 R W plate as applied to rail with square spikes.

INFORMATION REQUIRED WHEN ORDERING TIE PLATES

Weight and section of rail.

Width of rail base.

Style of plate.

Length of plate.

Width of plate.

Thickness of plate.

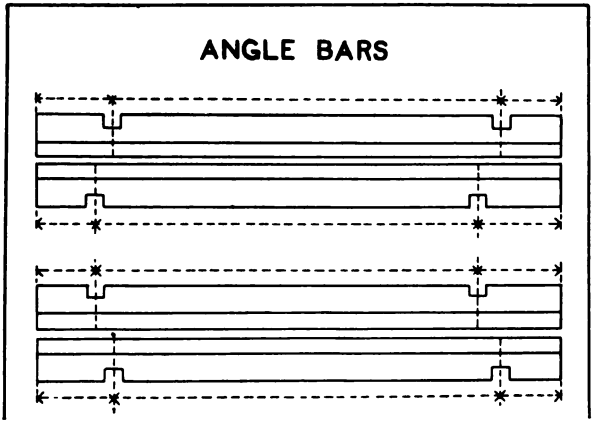
Height of shoulder.

Size of spikes to be used.

Number of holes required—if three holes, give distance between centers of inside holes.

State whether joint or intermediate plates are wanted.

NOTE: Where screw spikes are used the angle of the base of the rail must be given.



On joint plates the following information is also required:

Stagger of holes in angle bars.

What is the width out to out of angle bars?

Should shoulder of joint plates abut against rail or against angle bar? If against rail, send drawing showing clearance between angle (or splice) bar and rail (See page 13 for sketch of joint plates.)

TIE PLATES

NECESSARY DATA FOR ORDERING TIE PLATES

See illustration on opposite page

INTERMEDIATES TIE W

1. Number required.
2. Rail Base A.
3. Size of Spike.
4. Number of Holes wanted.
5. Length of Plate.
6. Width of Plate.
7. Thickness of Plate.

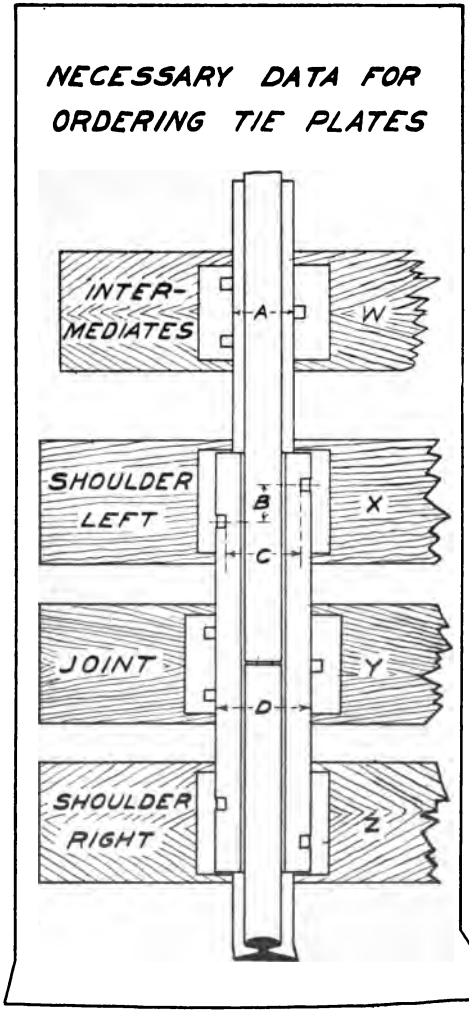
SHOULDER TIE X

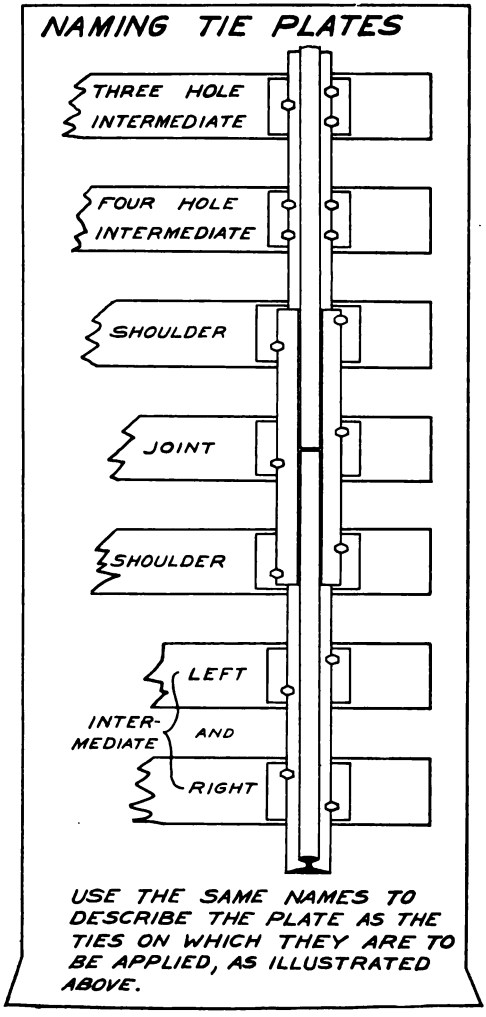
1. Number required.
2. Distance B.
3. Distance C.
4. Are slots in angle bar staggered left tie X or right tie Z.
5. Size of Slots.

JOINT TIE Y

1. Number required.
2. Distance D.

If angle bar is slotted, give same dimensions *as B & C* tie X.


NECESSARY DATA FOR
ORDERING TIE PLATES
INTER-
MEDIATES
A
W
SHOULDER
LEFT
B
C
X
JOINT
D
Y
SHOULDER
RIGHT
Z


NAMING TIE PLATES
THREE HOLE INTERMEDIATE
FOUR HOLE INTERMEDIATE
SHOULDER
JOINT
SHOULDER
LEFT
INTER-MEDIATE
AND
RIGHT
USE THE SAME NAMES TO DESCRIBE THE PLATE AS THE TIES ON WHICH THEY ARE TO BE APPLIED, AS ILLUSTRATED ABOVE.

ECONOMY TIE PLATES

A glance at Plate No. 1 shows wheel base contact with the head of the rail, at a point beyond the center axis, as applied to a common type of plate where rail-wear naturally begins.

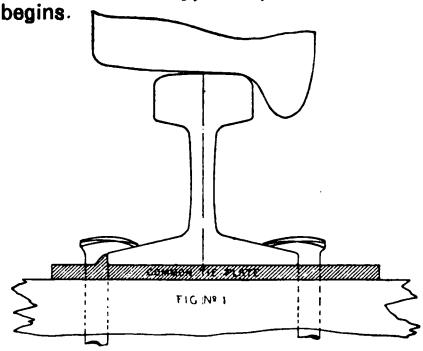


FIG. Nº 1

Plate No. 2.—Our Economy Tie Plate No. 8 applied with the reinforced features under the shoulder and two small transverse flanges, which prevents lateral movement on the tie. The incline or battering effect upon the top surface of the plate tilting the rail inwardly toward the center of the track, not to a degree of danger, which is shown by the vertical line through the web of the rail, but to a point of absolute safety, thus changes the wheel base contact and insures a greater rail wear, without impairing the efficiency of either the rail or tie plate.

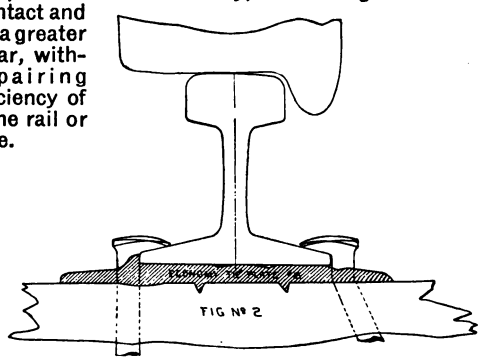


FIG Nº 2

IRON AND STEEL METALLURGY IN BRIEF

A SUMMATION OF THE PROCESSES WHICH RESULT IN VARIOUS DESCRIPTIONS OF PRODUCT FROM IRON ORE TO FINISHED FORMS

The following summary statement, which indicates the line of processes involved in the manufacture of iron and steel, beginning with iron ore and ending with the various forms of finished products, has been compiled by Eliot A. Kebler, 1844 Oliver Bldg., Pittsburgh, resident agent of M. A. Hanna & Co. With it are given chemical analyses of iron ore, pig iron, semi-finished steel and finished materials, including the products of iron and steel foundries:

FROM ORE TO FINISHED PRODUCT

IRON ORE contains Iron and Oxygen and impurities.

IRON ORE smelted in Blast Furnace, removing Oxygen and part of impurities and adding carbon, makes.....PIG IRON

FOUNDRY PIG IRON melted in Cupola and cast makes IRON CASTINGS

IRON CASTINGS made from Malleable Pig Iron and heated in Scale, make.....MALLEABLE CASTINGS

GREY FORGE PIG IRON melted in a Puddling Furnace, then balled, squeezed and rolled, makes.....MUCK BAR

MUCK BAR or Wrought Scrap cut into short lengths, piled, heated and rolled, makes.....WROUGHT IRON

MUCK BAR treated as above and rolled into strips, makes ..SKELP IRON

SKELP IRON bent into the shape of tubes and welded, makes IRON PIPE

MUCK BAR or Steel melted in a Crucible with Charcoal, makes Carbon Steel, Tool Steel or.....CRUCIBLE STEEL

MUCK BAR or Steel treated as above, with Tungsten added to raise the temperature at which it softens, Chromium to give toughness, and Vanadium, Titanium, Aluminum or other metals to improve the quality, heated to a high, then to a lower heat makes HIGH SPEED STEEL

BESSEMER PIG IRON direct from Blast Furnace or melted in Cupola, *poured into Converter*, with air blown through it to burn out the *impurities makes*.....BESSEMER STEEL

PIG IRON Molten, or in pig, with or without Scrap, when purified in Open Hearth Furnace makes.....OPEN HEARTH STEEL

LOW PHOS. PIG IRON treated as above in an acid (Silica or Sand) lined furnace makes.....ACID O. H. STEEL

BASIC PIG IRON treated as above in a basic (Dolomite) lined furnace to remove Phosphorus makes.....BASIC O. H. STEEL

BASIC O. H. STEEL with only about 1-10 of 1% impurities is called by various trade names, such as Toncan Metal, Genuine Open Hearth Iron and American Ingot Iron.

VANADIUM STEEL or Manganese (over 7%), Titanium or Nickel Steel is made by the addition of these metals, all being called ALLOY STEELS

STEEL purified in an Electric Furnace, makes....HIGH GRADE STEEL

STEEL is cast into ingot molds usually about 19 inches square and about 6 feet long, making.....INGOTS

INGOTS are rolled into.....BLOOMS OR BILLETS

BLOOMS are rolled into.....RAILS

BLOOMS are rolled into.....STRUCTURAL SHAPES

INGOTS are rolled into.....SLABS

SLABS are rolled into .....PLATES

INGOTS are rolled into.....SHEET BARS

SHEET BARS are rolled into.....SHEETS

SHEETS are cold rolled and stamped into.....FORMS

SHEET BARS are rolled into.....BLACK SHEETS

BLACK SHEETS cleaned and coated with Spelter (Zinc) make.....GALVANIZED SHEETS

BLACK SHEETS cleaned, cold rolled and coated with Tin make.....TIN PLATE

BLACK SHEETS cleaned, cold rolled and coated with Lead and Tin, make.....TERNE PLATE

INGOTS are rolled into.....BILLETS

BILLETS are rolled into.....BARS AND SMALL SHAPES

BILLETS are rolled into.....STEEL SKELP

STEEL SKELP bent into the shape of tubes and welded makes STEEL PIPE

BILLETS are pierced, rolled and drawn through dies, making.....SEAMLESS TUBES

BILLETS are rolled into .....RODS

RODS are drawn through dies into.....WIRE

WIRE is made into.....NAILS AND FENCING

RODS are headed into.....RIVETS AND BOLTS

RODS are welded into.....CHAIN

TYPICAL ANALYSES AND SPECIFICATIONS OF THE ABOVE

LAKE SUPERIOR IRON ORES (Natural Condition)

Brand	Loss on Ignition	Moisture	Iron	Sil.	Sul.	Phos.	Manganese
American (Marquette)	1.08	2.05	56.42	12.09	0.011	0.039	0.04
Montrose (Gogebic)	2.79	10.92	54.29	5.88	0.029	0.069	0.37
Dover (Mesaba)	4.26	13.37	51.89	5.03	0.009	0.068	0.54
Republic Basic Lump (Used in Open Hearth)	None	0.82	65.86	2.34	0.012	0.093	0.06
Beaver (Puddling Furnace fix)	10.71	4.12	56.27	2.69	0.028	0.072	0.38

PIG IRON

	Sil.	Sul.	Phos.	Mang.
High Phosphorus	1.75 to 2.50	0.05 & under	Over 1.00	0.35 to 0.70
No. 2 Foundry*	1.75 to 2.25	0.05 & under	0.40 to 0.60	0.50 to 0.80
Grey Forge*	0.75 & over	Over 0.05	0.40 to 0.60	0.50 to 0.80
Strong Foundry and Car Wheel	0.75 to 1.50	0.05 & under	0.30 & under	.....
Basic (Chill cast)	Not over 1.00	0.05 & under	.....	.....
Malleable	As desired	0.05 & under	0.20 & under	Not over 0.80
Bessemer	1.00 to 2.00	0.05 & under	0.10 & under	.....
Low Phosphorus	1.00 to 2.00	0.035 & under	0.035 & under	.....

*Mahoning and Shenango Valley.

IRON CASTINGS

	Total Car.	Sil.	Sul.	Phos.	Mang.
Light	3.40	2.75	0.075	0.75	0.40
Medium	3.50	1.75	0.080	0.55	0.60
Semi-Steel	3.30	1.30	0.075	0.40	0.45
Malleable	2.50	0.75	0.070	0.19	0.25

WROUGHT IRON

	Total Car.	Sil.	Sul.	Phos.	Mang.
Muck Bar	0.10	0.108	0.052	0.193	Not over 0.10
Skelp	0.05	0.040	0.050	0.10	Not over 0.10

TOOL STEEL

	Tungsten	Chromium	Car.	Sul.	Phos.	Sil.	Vanadium
Carbon Steel	.....	.....	1.10	0.03	0.015	0.20	.....
High Speed Steel	18.00	3.50	0.55	0.012 or less	Trace	Trace	1.00

STEEL BILLETS AND SHEET BARS

	Car.	Sul.	Phos.	Mang.
Bessemer	0.08 to 0.12	0.08 or less	0.09 to 0.12	0.35 to 0.50
Acid O. H.	0.08 to 0.12	0.06 or less	0.08 or less	0.35 to 0.50
Basic O. H. (Soft)	0.08 to 0.12	0.05 or less	0.05 or less	0.30 to 0.45
Basic O. H. (Phos. added)	0.08 to 0.12	0.05 or less	0.08	0.40 to 0.50
Am. Ingot Iron	0.02	0.021	0.005	Trace

RAILS

(Chemical Specifications, Asso. of Amn. Steel Manufacturers)

	Car.	Sil.	Phos.	Mang.
Bessemer.....	0.35 to 0.55	Not over 0.20	Not over 0.10	0.70 to 1.14
Open Hearth.....	0.46 to 0.75	Not over 0.20	Not over 0.04	0.60 to 0.90

STEEL CASTINGS

(Extract from Specifications, Amer. Society for Testing Materials)

	Minimum Physical Requirements				Maximum		
	Tensile strength lb. per sq. in.	Yield point lb. per sq. in.	Per cent. elong. in 2 in.	Per cent. red. in area	Car.	Sul.	Phos.
Ordinary Castings....	None Required				0.40	.....	0.08
Tested Cstgs., Hard..	85,000	38,250	15	20	.....	0.05	0.05
Tested Cstgs., Medium.....	70,000	31,500	18	25	.....	0.05	0.05
Tested Cstgs., Soft...	60,000	27,000	22	30	.....	0.05	0.05

BOILER PLATE AND RIVET STEEL

	Flange Steel	Fire Box Steel	Extra Soft Steel
Phos. not to exceed	Acid 0.06% Basic 0.04%	Acid 0.04% Basic 0.03%	0.04%
Sul. not to exceed	0.05%	0.04%	0.04%
Manganese	0.30 to 0.60%	0.30 to 0.50%	0.30 to 0.50%
Ult. T. S. lb. per sq. in.	55,000–65,000	52,000–62,000	45,000–55,000
Yield point, lb. sq. in. not under.	½ Ult. T. S.	½ Ult. T. S.	½ Ult. T. S.
Elong. % in 8 in. not under	1,500,000	1,500,000	1,500,000
	Ult. T. S.	Ult. T. S.	Ult. T. S. (but need not be over 30%)
Cold bend Quench bend	180° flat	180° flat	180° flat

STRUCTURAL STEEL FOR BUILDINGS

	Struc. Steel	Rivet Steel O. H.
Phosphorus, maximum, Bessemer	0.10 per cent.	.....
Phosphorus, maximum, Open Hearth	0.06 per cent.	0.06 per cent.
Ultimate tensile strength, pounds per square inch	55,000–65,000	48,000–58,000
Yield point	½ Ult. tens. str.	½ Ult. tens. str.
Elongation, minimum, per cent. in 8 inches	1,400,000	1,400,000
	Ult. tens. str.	Ult. tens. str.
Character of fracture	Silky	Silky
Cold bend without fracture	180° to dia. of 1 thickness	180° flat

SUGGESTED BLANK FORM FOR COST ESTIMATING

Full size (8½" x 14") blank forms furnished on request to the Spencer Otis Company, Railway Exchange, Chicago.

ESTIMATE OF COST
of the

.....
From.....at Engineers Station.....
To.....at Engineers Station.....
A distance of.....miles, situate in.....County.....
See Map No.....Profile No.....
Remarks.....

History and Physical Characteristics.

Locating Engineer.....Surveys began.....
Ended.....Grading started.....Track laying began
.....completed.....Commenced operation.....
Length of main line.....miles, Sidings.....miles, Total
.....miles. Ruling Grade East.....West.....Sum of ascents in feet East.....West.....Track on ruling grade, East.....West.....Maximum curve.....degrees. Total Curvature.....degrees. Average.....degrees. Track on Curve.....miles. On Tangent.....miles. Roadbed, Embankment.....Slopes.....Excavation.....slopes.....

——:::——

Acct.	Items.	Cost per Mile	Total Cost	% of Total
201	Engineering.	.....	.....	.....
202	Right of Way and Station Grounds.			
	.....Acres at $.....per acre.....			
	.....	.....	.....	.....
203	Real Estate.			
	.....Acres at $.....per acre.....			
	.....	.....	.....	.....
204	Grading.			
	....Acres clearing at $....per acre...			
	.... " grubbing at $.... " ...			
	....c. y. earth exc. at $.... c. y.....			
	.... " L. R. " at $.... "			
	.... " S. R. " at $.... "			
	.... " " at $.... "			
	.... " earth emb at $.... "			
	....			
		.....	.....	.....
205	*Tunnels.*			
	.....			
	.....	.....	.....	.....

Acct.	Items.	Cost per Mile	Total Cost	% of Total
206	**Bridges, Trestles and Culverts.**			
	.....Lin. ft. wooden boxes (trtd), at $.....			
	.....			
	.....Lin. ft., C. I. Pipe, at $.....			
	.....			
	.....Lin. ft. Pile Brdgs (trtd.) at $..... p. f. $.....			
	" " Temp'ry, at $..... " $.....			
	.....Tons T. Rail Brdge, at $..... p. t. $.....			
	..... " I Beams, at $..... " $.....			
	..... " Deck Girders, at $..... " $.....			
	..... " Through " at $..... " $.....			
	..... " Truss at $..... " $.....			
	.....c. y. Concrete sub., at $..... c. y. $.....			
	.....Lin. ft. Piling, at $..... p. f. $.....			
	Ft. BM Lumber, F. Wk., at $..... " $.....			
	Freight, Etc.....			
	.....			
	.....			
		.....	.....	.....
207	**Ties.**			
	.....Ties at.....Per mile. Kind.....			
	Treated, at.....per tie, $.....			
	.....Sets No. 9 Switch Ties, at $.....			
	..... " " " " $.....			
	Freight, Etc.....			
	.....			
		.....	.....	.....
208	**Rail.**			
	.....Tons.....lb. rail,.....lengths for main line at $.....per ton, basis.....tons per mile.			
	.....Tons.....lb. rail,.....lengths for sidings at $.....per ton. Basis.....tons per mile.			
	Freight, Etc.....			
	.....			
		.....	.....	.....
209	**Frogs and Switches.**			
	Spring Rail for M. L. Rigid for Sidings.			
	.....#9 Swi. Comp. for M. L., at $..... $.....			
	.....#9 " " " at $..... $.....			
	.....#9 " " yards, at $..... $.....			
	.....#9 " " " at $..... $.....			
	Includes Guard Rails, Switch Stands, Etc.			
	.....			
	Freight, Etc.....			
	.....			
	.....			
		.....	.....	.....
210	**Track Fastenings.**			
	.....RAIL JOINTS. Kind.....			
	Length.....No. Holes.....Weight per pair.....No. per mile.....Weight per mile.....lbs. Cost per pair .....Cost per mile.....			
	Freight, Etc.....			
	.....			
	.....			
		.....	.....	.....

Acct.	Items.	Cost per Mile	Total Cost	% of Total
	.....ANGLE BARS. Weight.....Length.....No. Holes.....Weight per pair.....lbs. No. per mile..... Weight per mile.....lbs. Cost per mile $..... Cost per pair $..... Freight, Etc.....			
	Bolts: Main Line: Size.....Kegs.....Weight per keg 200 lbs. No. Kegs per mile.....Weight per mile.....Cost per keg .....Cost per mile.....			
	Bolts: Sidings: Size.....Kegs.....Weight per keg.....No. kegs per mile.....Weight per mile.....lbs. Cost per keg .....Cost per mile..... Freight, Etc.....			
	SPIKES: Size.....Kegs.....Weight per keg, 200 lbs. No. kegs per mile.....Weight per mile.....lbs. Cost per keg.....Cost per mile..... Freight, Etc.....			
	TIE PLATES:.....Plates at.....per mile. Kind..... Weight per plate.....lbs. Weight per mile.....lbs. Cost per plate. Freight, Etc.....			
211	Ballast. .....c. y., at $.....per yard. Basis.....inches... c. y. per mile. Freight, Etc.....			
212	Track Laying and Surfacing. Main line at.....per mile. Sidings at..... "			
213	Roadway Tools. One Set for every 7 miles of M. L. .....*Sets at* $.....per Set.			

Acct.	Items.	Cost per Mile	Total Cost	% of Total
214	Fencing Right of Way.			
	No. of wires.....Fence posts.....ft. apart. At $.....			
	per mile, both sides of track.....Cattle guards at $.....			
	.....Gates at $.....			
	Freight, Etc.....			
	.....			
	.....	.....	.....	
215	Crossings, Signs, Etc.			
	.....Farm crossings at $..... = $.....			
	.....Pub. Road " at $..... = $.....			
	.....Signs at $..... = $.....			
	.... at $..... = $.....			
	Freight, Etc.....			
	.....	.....	.....	
216	Interlocking and Signal Apparatus.			
	.....			
	.....			
	.....			
	Freight, Etc.....			
	.....	.....	.....	
217	Telegraph and Telephone.			
	.....Poles per mile.....Length.....Wires on brackets or crossarms.....Miles at $.....			
	Freight, Etc.....			
	.....			
	.....	.....	.....	
218	Station Buildings and Fixtures.			
	.....Depots, size .....X....., at $..... = $.....			
	..... " " .....X....., at $..... = $.....			
	..... " " .....X....., at $..... = $.....			
	.....No. ....Stock Yards, Size....X...., at ..... $.....			
	..... " ..... " " ....X...., at $..... $.....			
	.....Track scales....Tons cap at $.....			
	.....			
	.....			
	Freight, Etc.....			
	.....	.....	.....	
219	General Office Buildings and Fixtures.			
	.....			
	.....			
	.....	.....	.....	
220	Shops, Roundhouses and Turntables.			
	.....Stall Roundhouse.....Construction, at $.....			
	per stall = $.....			
	.....ft. turntable, incl. pit $.....			
	.....Cinder pit.....long, $.....			
	.....Sand House, size....$.....			
	.....			
	.....			
	.....			
	Sewerage, Water Systems, Etc.			
	.....			
	Freight, Etc......			
	.....			
	.....	.....	.....	

Acct.	Items.	Cost per Mile	Total Cost	% of Total
221	Shop Machinery and Tools.			
	.....			
	.....			
		.....	.....	.....
222	Water Stations.			
	.....Steel Tanks .....X....., at ..... = $.....			
	.....Pumphouses .....X....., at $..... = $.....			
	.....Wells.....deep, at $.....per ft..... = $.....			
	.....			
	.....			
	.....			
	Freight, Etc.....			
		.....	.....	.....
223	Fuel Stations.			
	.....Tons capacity coal chute $.....at $.....per ton.			
	.....			
224	Grain Elevators.			
225	Storage Warehouses.			
226	Docks and Wharves.			
227	Electric Light Plants.			
228	Electric Power Plants.			
229	Electric Power Transmission.			
230	Gas Making Plants.			
231	Miscellaneous Structures.			
	.....Section houses.....X....., at $..... = $.....			
	.....Bunk houses .....X....., at $..... = $.....			
	.....Tool houses .....X....., at $..... = $.....			
	.....Ice houses .....X....., at $..... = $.....			
	.....Oil houses .....X....., at $..... = $.....			
	.....Coal houses .....X....., at $..... = $.....			
	.....			
	.....			
	.....			
	.....			
		.....	.....	.....
232	Transportation of men and material.			
233	Rental and equipment.			
234	Repairs to Equipment.			
235	Earnings and Operating Expenses.			
236	Cost of Road Purchased.			
237	Steam Locomotives.			
238	Electric Locomotives.			
239	Passenger Cars.			
240	Freight Cars.			
241	Work Equipment.			
242	Floating or Marine Equipment.			
243	Legal Expenses.			
244	Stationery and Printing.			
245	Insurance.			
246	*Taxes.*			
247	*Interest and Commissions.*			
248	*Other Expenditures.*			

INTRODUCTION

One of the many small problems which has for years perplexed the railroad managements has been to find some method of retaining a nut upon a bolt. The importance of having such a nut has been recognized by the numberless attempts that have been made to perfect such a device. Perfection in a lock nut is found only in the absolute locking of the nut.

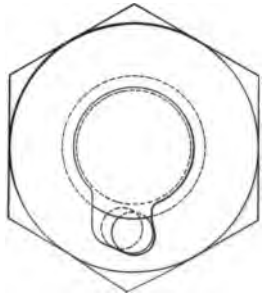
The Absolute Lock Nut, fulfilling all demands made upon it, constitutes the best insurance against expense, danger and disaster. To meet all requirements, a lock nut must be absolute in its action, and in the Absolute Lock Nut has been found, by the severest tests, the complete solution of the problem.

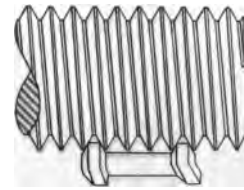
The following pages are devoted to illustration and explanation of the Absolute Lock Nut.

ABSOLUTE LOCK NUT

The principle of the Absolute Lock Nut is that of a rolling wedge.

The device is a recess cut in the inner surface of the nut, in which recess rests a locking pin. The recess is





so formed that while the nut is being turned on, the pin rests in the deeper portion of the recess and does not interfere with the motion of the nut. As soon as the direction of the turn of the nut is reversed, the pin is wedged against the bolt, absolutely locking.

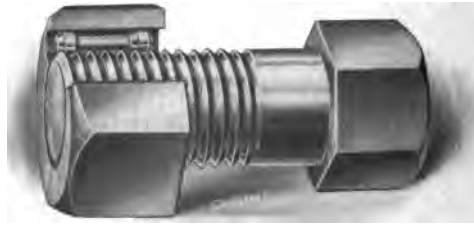
This pin is so formed that the head on each end conforms to the angle of the thread, and in no wise injures the thread during application or removal.

This locking device has the effect of a continuous ratchet, as any vibration of the nut can cause it to move only toward a tighter position, and no backward movement is ever permitted.

The Absolute Lock Nut can be applied and removed repeatedly without injuring the threads of the bolt or the nut. The greater the force tending to loosen the nut the tighter it locks. This nut lock can be applied to any standard bolt using U. S. Standard Thread. Any nut, hexagon or square, can be equipped.

Tests have been made by the Michigan Central Railroad, at Detroit, Mich., the results of which are set forth as follows:

"Tests were made in tension and in all cases the bolts broke in the stock below the nuts, showing that the strength of the Absolute Lock Nut was not injured by the recess."



The retaining device holds the locking pin in position during installation. It is furnished in the nut, in position, ready for application, so that the Absolute Lock Nut can be applied in the same manner as an ordinary nut. It is entirely automatic in its action, with a perfectly free movement, and it does not retard the movement of the pin in the nut when applied or when removed.

Absolute Lock Nut Retaining Device, showing the method of holding the locking pin in correct position for application.

REMOVAL

To remove the Absolute Lock Nut from the bolt, a wire nail or brad of sufficient size is inserted between the wall of the shallow portion of the recess and the locking pin, thereby holding the pin in deeper portion of the recess, which disengages the heads of the locking pin from the threads of the bolt, permitting the nut to be easily removed.

Absolute Lock Nuts have been removed from bolts where they have been in service for three years, without any difficulty, while, on the other hand, they have required no maintenance, and have never been tightened during the three years. Rust and dirt had completely filled the end of the recess of the nut without doing it any harm, and after three years' service, none of the bolts have been affected.

Note Illustration showing position of nail or brad *when lock is released* and nut ready to be removed.

One of the greatest advantages of the Absolute Lock Nut is that it is a self-contained device and does not require the use of lock washers or cotter keys. This makes possible the use of from ¼-inch to ½-inch shorter bolts than heretofore, and results in considerable saving when the quantity of bolts is considered.

Illinois Northern Railway Crossing with Pennsylvania Lines at Twenty-sixth and Western Ave., Chicago. Equipped with Absolute Lock Nuts October, 1912. Inspection August, 1913, shows all Absolute Lock Nuts tight and in perfect condition. Superintendent reports these nuts have received no attention during this time. The ratchet or self-tightening feature of the Absolute has taken up stretch of bolts, and wear of rough parts. The fact that all of these nuts have held tight, has eliminated all breakage of bolts. The common nut locks on this crossing which were previously used required tightening every four or five days and frequent renewals of bolts. The first cost being the same as that of the ordinary nut locks make it an easy matter to figure the enormous saving by equipping with the Absolute.

The following is a comparative estimate of the saving derived from the use of Absolute Lock Nuts on rail joints:

⅞ TRACK BOLT

1408 bolts to mile (4 to joint) saves 122 lbs. of material at 2¾ cents per lb	$ 3.35
1408 lock washers at $6.00 per M	8.44
The renewals every 6 months of above	8.44
Labor tightening nuts eliminated by use of the Absolute at approximately 25 cents a mile per month, one year	3.00
Depreciation from wear and loss on bolts caused from nuts becoming loose and dropping off estimated at about 25 cents a mile per month, one year.	3.00
	$26.23

2112 bolts to mile (6 to joint) saves 183 lbs. of material at 2¾ cents per lb	$ 5.02
2112 lock washers at $6.00 per M	12.67
The renewals every 6 months	12.67
Labor tightening nuts eliminated by use of the Absolute at approximately 25 cents a mile per month, one year	4.00
Depreciation from wear and loss on bolts caused from nuts becoming loose and dropping off estimated at about 25 cents a mile per month, one year.	4.00
	$38.26

In compiling the above comparative estimate, figures *were based on* tests covering a period of three years.

The following is a comparative estimate of the saving derived from the use of Absolute Lock Nuts on crossings:

48—1⅛ inch bolts in crossing saves 10 lbs. of material at 2 9-10 cents per lb	$ 0.29
48 lock washers, eliminated by the Absolute	.29
Renewal of bolts every two months, 96 bolts at 17.3 cents each	16.61
Labor cost for installing new bolts 5 men 5 hours each, total 25 hours at 15 cents per hour	3.75
Labor cost for tightening nuts which is eliminated by the use of the Absolute, one man 1 hour each week, 26 weeks, total 26 hours at 15 cents per hour	3.90
	$24.84

In compiling the above comparative estimate, figures were based on tests covering a period of six months.

ERRATA

Page 45:

Line 4 in the first paragraph, reading "or with two", should read "or with four".

Page 91:

Caption under the first illustration reads: "No. 9-RW". This should read: "No. 9-S".